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THE WORK OF THE SCOTTSBLUFF EXPERIMENT FARM IN 1920 AND 1921.

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INTRODUCTION.

It has been the aim of the Scottsbluff Experiment Farm to conduct such experimental work as will be of practical value to farmers on irrigated lands in western Nebraska and those farming the adjacent dry lands, in assisting them to produce larger crops and to utilize these crops to the best advantage. This report deals particularly with the results obtained in 1920 and 1921, and gives a brief survey of the agricultural situation on the North Platte Reclamation Project during that period.

CONDITIONS ON THE NORTH PLATTE RECLAMATION PROJECT.

CLIMATE.

The weather conditions on the project during the summers of 1920 and 1921 were fairly favorable for crop production. While neither summer was as favorable as the summer of 1918, both were better than the summer of 1919. The early spring of 1920 was unusually wet and cold, which delayed field work until rather late. On April 17, 18, and 19 occurred one of the worst blizzards in the history of the project. Thousands of cattle that had already gone to the range perished. The wet spell was followed by very dry weather which made it difficult to get sugar beets up.

The spring of 1921 opened up unusually early but was very dry and windy. There was practically no precipitation from early February until after the middle of May. Due to favorable weather most crops were seeded earlier than usual. Most of the beets were planted by the end of April, but owing to the dry weather they

did not come up until after the rains which began on May 17. Even some of the small grain did not germinate until after these rains. From May 17 until about June 10 the rains were rather frequent. The stands of most crops were good except in places where they were washed out by excessive rains. From June 10 to the end of the growing season the rainfall was very light.

The total precipitation for 1920 was 16.86 inches. The last frost in the spring was on May 7, with a minimum temperature of 30° F., and the first frost in the fall was on September 26, with a minimum temperature of 31° F., making a total frost-free period of 141 days.

In 1921 the total precipitation was 12.58 inches. The last frost in the spring was on May 12, with a minimum temperature of 28° F., and the first frost in the fall was on September 29, with a minimum temperature of 31° F., making a total frost-free period of 139 days.

The maximum temperature in 1920 was 100° F., and the minimum was 21° below zero. In 1921 the maximum was 99° F., and the minimum 16° below zero. A summarized statement of the climatological data is given in Table 1.

TABLE 1.—*Summary of climatological observations made at the Scottsbluff Experiment Farm, 1911 to 1921, inclusive.*

PRECIPITATION (INCHES).

Item.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average, 1911–1921	0.23	0.26	0.56	2.09	2.85	1.74	1.58	1.80	1.87	0.90	0.22	0.47	14.60
For 1920	.29	.41	.67	2.05	4.13	2.09	3.27	1.80	.57	1.16	.09	.33	16.86
For 1921	.76	.10	.14	.57	3.31	1.37	1.55	1.21	1.14	.93	.53	.77	12.58

EVAPORATION (INCHES).

Average, 1911–1921	.....	.....	.....	4.60	6.12	6.42	7.96	6.34	5.13	.....	.....	.....	38.00
For 1920	.....	.....	.....	3.15	5.03	6.56	8.00	6.77	4.90	.....	.....	.....	34.41
For 1921	.....	.....	.....	5.14	5.55	6.65	8.41	6.59	5.62	.....	.....	.....	37.96

DAILY WIND VELOCITY (MILES PER HOUR).

Highest:													
1911–1921	29.9	24.5	24.2	31.4	16.6	16.7	9.1	9.2	13.1	23.1	15.6	16.7	.....
For 1920	10.3	12.0	18.6	21.1	15.5	9.0	8.5	6.3	6.0	7.0	9.8	13.8	.....
For 1921	11.9	13.0	11.1	14.7	12.0	10.4	8.3	6.8	13.1	11.0	8.1	14.6	.....
Lowest:													
1911–1921	.8	.4	.5	1.4	.1	.1	.4	.2	.1	.8	.5	.3	.....
For 1920	2.0	1.7	1.6	2.6	2.4	3.2	1.8	1.6	1.1	1.6	1.4	1.3	.....
For 1921	.9	.4	2.5	2.5	2.8	1.6	1.9	1.8	1.8	1.3	1.1	1.4	.....
Mean:													
1911–1921	6.0	5.9	6.8	7.6	7.2	5.7	4.2	3.8	4.3	5.0	4.8	5.3	.....
For 1920	5.2	5.8	7.1	7.5	7.4	5.7	3.8	3.0	2.6	3.6	4.0	4.6	.....
For 1921	4.8	4.4	6.7	7.4	7.5	4.8	3.8	3.1	4.6	4.6	4.0	4.8	.....

TEMPERATURE (° F.).

Absolute maximum:													
1911–1921	68	68	81	95	92	101	101	99	94	88	75	90	.....
For 1920	65	60	71	72	89	95	100	91	91	87	68	60	.....
For 1921	63	68	81	80	85	99	98	97	89	84	72	58	.....
Absolute minimum:													
1911–1921	−28	−23	−15	−2	22	30	40	40	22	1	−21	−33	.....
For 1920	−11	−10	−15	−2	30	35	42	43	31	17	4	−21	.....
For 1921	−5	−2	14	15	28	44	45	46	31	23	−1	−16	.....
Mean:													
1911–1921	24	26	35	38	55	65	71	69	59	47	36	24	.....
For 1920	29	27	33	36	53	65	71	67	61	49	33	25	.....
For 1921	27	31	42	44	55	68	73	70	61	52	35	24	.....

TABLE 1.—*Summary of climatological observations made at the Scottsbluff Experiment Farm, 1911 to 1921, inclusive*—Continued.

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Length of frost-free period (days).
	Date.	Minimum temperature (° F.).	Date.	Minimum temperature (° F.).	
1911	May 26	28	Oct. 3	31	129
1912	May 13	30	Sept. 16	31	124
1913	May 2	26	Sept. 19	31	124
1914	May 7	32	Sept. 13	30	129
1915	June 12	32	Oct. 3	32	113
1916	May 2	24	Sept. 14	30	133
1917	May 21	32	Oct. 7	28	136
1918	May 9	31	Sept. 15	32	129
1919	June 2	30	Sept. 21	32	111
1920	May 7	30	Sept. 26	31	141
1921	May 12	28	Sept. 29	31	139

CROP CONDITIONS.[1]

The crop yields on the North Platte project for 1920 and 1921 were fairly good and had the prices of 1919 prevailed the returns would have been higher than in any previous year. Even if the 1920 prices prevailing at harvest time had been realized by the farmers, the gross returns from the 1920 crops would have reached the highest point in the history of the project, a total valuation of $4,043,637. Before most of the crops, except sugar beets, were marketed there was a severe break in prices.

There was a real increased return in 1920 from the sugar-beet crop. The acreage was almost 50 per cent higher than in 1919, being 16,558 acres as compared with 10,965 acres. The prices paid for beets were also higher than those paid in 1919, being $12 per ton for beets from the fields and $13 for siloed beets. These two increases resulted in a valuation for beets of $2,168,638, as compared with $1,279,410 for 1919, or an increase of $889,228. Potatoes showed an increased yield of about 30 per cent, but the yields of all other crops were much the same as the previous year. The value per unit of yield was from 25 to 75 per cent, or an average of 43 per cent less than the prices received in 1919. The shrinkage in value was emphasized by the fact that crops were produced with the highest priced labor the valley has ever known. Taking it all in all, the net results for the year were rather unfavorable.

The season of 1921 was fairly favorable so far as weather conditions were concerned. The yields per acre were practically the same as for 1920, but the decrease in crop values continued, amounting to an average of about 50 per cent. The gross returns dropped to $2,406,920, or $27.94 per acre, as compared with $46.53 for the previous year. The price of beets was cut from $12 per ton to $7 per ton, but this reduction carried with it a drop in the price of beet labor from $35 to $22 per acre. The price of all other grades of labor came down in proportion, so that the reduced price of beets was not so serious to the grower as it was to the landowner. The customary rental of beet lands in the valley is one-fifth of the beets delivered at the dump. On this basis a 15-ton yield in 1921 would net the owner $21 per acre, as compared with $36 for 1920. The beet acreage was

[1] The statistics used in this discussion apply only to the Interstate Unit of the North Platte project and not to the whole irrigated area of the North Platte Valley.

reduced by about 2,000 acres and the potato acreage increased about 3,500 acres. This increase in the acreage of potatoes was rather generally distributed over the project. This was fortunate, as there was a ready demand for potatoes at digging time, with good prices. This resulted in a general distribution of cash from this crop, though in some cases in rather small amounts. Potatoes and beets were the only important cash crops in 1921.

Owing to a break in the main canal just at the peak of the irrigation season, the alfalfa crop was very light and few farmers made any surplus. The break, which interrupted the water service for 10 days to two weeks, also reduced the yields of all grain crops materially, for at that season of the year a few days' delay in irrigation meant serious loss. The abnormal conditions existing in 1921 in so far as prices are concerned make difficult any comparisons of values with other years.

Table 2 gives a summary of the crops and values on the Interstate Unit for the years 1920 and 1921, as published by the Reclamation Service. Table 3 gives a digest of the acreage, yields, and returns of the most important crops grown on this unit since 1910.

TABLE 2.—*Acreage, yields, and farm values of crops grown on the North Platte Reclamation Project (Interstate Unit) in 1920 and 1921.*

Crop.	Area (acres).	Unit of yield.	Yields.		Farm values.		
			Total.	Average per acre.	Per unit of yield.	Total.	Per acre.
1920.							
Alfalfa hay	31,625	Ton	67,483	2.1	$10.00	$674,830	$21.34
Alfalfa seed	30	Bushel	30	1.0	15.00	450	15.00
Barley	3,922	...do	98,394	25.1	.55	54,117	13.80
Beans	86	...do	661	7.7	3.00	1,983	23.06
Cane	261	Ton	612	2.3	4.00	2,448	9.38
Clover (sweet) seed	91	Bushel	526	5.8	15.00	7,890	86.70
Corn	10,176	...do	191,671	18.8	.75	143,753	14.13
Corn fodder	31	Ton	73	2.4	4.00	292	9.42
Garden	329					25,463	77.40
Hay, miscellaneous	528	Ton	675	1.3	12.00	8,100	15.34
Millet	335	...do	3,235	9.7	1.00	3,235	9.66
Oats	7,708	Bushel	216,507	28.1	.60	129,904	16.85
Pasture:							
Alfalfa	1,243	Acre			15.00	18,645	15.00
Sweet clover	378	...do			15.00	5,670	15.00
Potatoes	5,799	Bushel	852,733	147.0	.75	639,550	110.29
Rye	611	...do	5,151	8.4	1.00	5,151	8.43
Sugar beets	16,558	Ton	173,491	10.5	12.50	2,168,638	130.97
Wheat	5,971	Bushel	96,453	16.2	1.50	144,680	24.23
Miscellaneous	151	Acre				8,838	58.53
Total or average	85,833					4,043,637	46.53
1921.							
Alfalfa hay	30,979	Ton	53,989	1.7	4.50	242,950	7.84
Alfalfa seed	77	Bushel	125	1.6	9.00	1,125	14.61
Barley	3,413	...do	100,079	29.0	.35	35,028	10.26
Beans	65	...do	284	4.4	1.50	426	6.55
Beets:							
Sugar	14,844	Ton	166,904	11.2	6.75	1,126,602	75.90
Stock	5	...do	96	19.0	4.00	384	76.80
Clover (sweet) seed	133	Bushel	298	2.2	9.00	2,682	20.16
Corn	9,462	...do	159,765	17.0	.35	55,918	5.91
Corn fodder	117	Ton	284	2.0	2.00	568	4.85
Cucumbers	107					4,135	38.64
Garden	316					13,037	41.25
Hay, miscellaneous	482	Ton	490	1.0	5.00	2,450	5.08
Millet seed	229	Bushel	1,493	6.5	1.00	1,493	6.52
Oats	9,504	...do	239,359	25.0	.25	59,840	6.30
Pasture:							
Alfalfa	992	Acre			6.00	5,952	6.00
Sweet clover	398	...do			6.00	2,388	6.00
Potatoes	9,300	Bushel	1,228,963	132.0	.65	798,826	85.89
Rye	454	...do	2,861	6.0	.50	1,430	3.15
Wheat	4,552	...do	62,803	14.0	.75	47,102	10.35
Miscellaneous	150					4,584	30.56
Total or average	85,579					2,406,920	27.94

TABLE 3.—*Statistical summary of acreage, yields, and farm values of the principal crops grown on the North Platte Reclamation Project from 1910 to 1921, inclusive.*

[Based on the published reports of the United States Reclamation Service.]

Item and year.	All crops.	Alfalfa.	Beets.	Potatoes.	Corn.	Barley.	Oats.	Wheat.
Acreage:								
1910	42,362	3,707	283	3,854	5,207	1,138	11,419	9,597
1911	44,736	8,880	343	3,190	4,563	902	12,271	6,715
1912	50,250	19,512	667	1,192	6,260	1,156	10,093	4,390
1913	55,829	27,298	2,920	1,156	3,561	2,331	8,590	2,182
1914	60,532	32,464	5,083	1,097	6,024	2,261	7,017	609
1915	70,007	31,788	7,872	1,395	10,343	2,329	7,112	1,878
1916	75,620	32,601	9,024	1,735	6,715	4,857	10,375	2,617
1917	83,203	34,374	9,357	4,833	6,051	3,052	10,173	3,128
1918	85,308	37,863	6,391	6,203	6,627	3,550	7,997	9,097
1919	85,690	33,446	10,968	6,284	9,107	3,720	6,620	9,767
1920	85,833	31,655	16,558	5,799	10,176	3,922	7,708	5,971
1921	85,579	31,056	14,844	9,300	9,462	3,413	9,504	4,552
Production:		*Tons.*	*Tons.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
1910		7,763	1,126	139,440	15,806	8,545	151,773	85,127
1911		18,883	2,439	44,316	62,454	12,935	183,287	82,376
1912		42,604	7,132	121,392	96,821	31,064	295,360	75,354
1913		61,728	32,739	151,304	67,001	49,522	211,599	32,489
1914		71,405	53,282	159,027	93,186	53,022	146,211	9,979
1915		62,491	97,753	251,833	209,626	87,037	198,692	33,785
1916		59,706	92,104	274,100	125,911	106,096	191,204	28,207
1917		58,656	99,790	1,119,626	117,008	94,868	243,764	47,467
1918		66,713	72,684	1,035,956	119,319	106,080	168,990	133,103
1919		70,109	116,310	713,257	157,699	101,067	159,815	165,536
1920		67,483	173,491	852,733	191,671	98,394	216,507	96,453
1921		53,989	166,904	1,228,963	159,765	100,079	239,359	62,803
Average yield per acre:								
1910		2.0	4.0	39.0	3.0	8	13	9.0
1911		2.1	7.0	14.0	14.0	14	15	12.0
1912		2.2	11.0	102.0	15.0	27	29	17.0
1913		2.3	11.0	131.0	19.0	21	25	15.0
1914		2.2	10.5	145.0	15.0	23	21	16.0
1915		2.0	12.5	181.0	20.0	37	28	18.0
1916		1.8	10.2	158.0	19.0	22	18	11.0
1917		1.7	10.7	231.7	19.3	31	24	15.2
1918		1.8	11.4	167.0	18.0	30	21	15.0
1919		2.1	10.6	113.5	17.3	27	24	17.0
1920		2.1	10.5	147.0	18.8	25	28	16.2
1921		1.7	11.2	132.0	17.0	29	25	14.0
FARM VALUE.								
Per unit of yield:								
1910		$7.00	$5.00	$0.50	$0.35	$0.35	$0.40	$0.70
1911		6.00	5.00	.75	.60	.60	.50	.75
1912		5.00	5.60	.25	.40	.50	.35	.67
1913		5.00	5.50	.45	.70	.60	.40	.63
1914		4.50	5.50	.35	.75	.60	.40	.85
1915		5.00	5.50	.40	.50	.45	.40	.90
1916		7.50	6.26	.90	.70	.60	.50	1.20
1917		17.00	7.50	.80	1.50	1.20	.70	1.80
1918		13.00	10.75	.60	1.50	1.10	.80	1.90
1919		15.00	11.00	1.00	1.30	1.25	.80	1.90
1920		10.00	12.50	.75	.75	.55	.60	1.50
1921		4.50	6.75	.65	.35	.35	.25	.75
Per acre:								
1910	$6.47	14.66	19.90	18.09	1.06	2.62	5.32	6.21
1911	8.67	12.76	35.55	10.42	8.21	8.60	7.47	9.20
1912	11.04	10.92	59.88	25.46	6.19	13.44	10.24	11.50
1913	14.40	11.31	61.67	58.90	13.17	12.75	9.85	9.38
1914	14.95	9.90	57.65	50.74	11.60	14.07	8.33	13.93
1915	18.55	9.83	68.30	72.21	10.13	16.82	11.18	16.19
1916	21.85	13.74	63.79	142.18	13.13	13.10	9.21	12.93
1917	41.92	29.00	79.99	185.33	29.01	37.30	16.77	27.31
1918	36.35	22.91	122.26	100.21	27.01	32.87	16.91	27.80
1919	45.71	31.44	116.65	113.50	22.51	33.96	19.31	32.24
1920	46.53	21.34	130.97	110.29	14.13	13.80	16.85	24.23
1921	27.94	7.84	75.90	85.89	5.91	10.26	6.29	10.35
Total:								
1910	274,217	54,341	5,630	69,720	5,532	2,990	60,709	59,588
1911	388,225	113,298	12,195	33,237	37,472	7,761	91,643	61,782
1912	521,455	213,020	39,939	30,348	38,728	15,532	103,376	50,487
1913	786,619	308,640	180,064	68,086	46,900	29,713	84,639	20,468
1914	890,202	321,322	293,051	55,659	69,889	31,813	58,484	8,482
1915	1,263,616	312,455	537,641	100,733	104,813	39,166	79,476	30,406
1916	1,633,389	447,795	575,650	246,690	88,137	63,657	95,602	33,848
1917	3,385,059	997,152	748,425	895,700	175,512	113,841	170,634	85,440
1918	3,100,711	867,269	781,353	621,573	178,978	116,688	135,192	252,895
1919	3,916,736	1,051,635	1,279,410	713,257	205,008	126,333	127,852	314,518
1920	4,043,637	674,800	2,168,638	639,550	143,753	54,117	129,904	144,680
1921	2,406,920	242,950	1,126,602	798,825	55,918	35,028	59,840	47,102

LIVESTOCK.

The livestock industries on the project show slight increases in some lines and marked decreases in others. There was a slight decrease in the number of horses in 1921 from that of the previous three years. This may be due in a measure to the increased use of trucks and tractors, but perhaps the greatest factor is that the farmers are getting larger and better horses and can therefore cut down on the number. Beef cattle show an increase, while the number of dairy cows has declined. The sheep industry has fallen off very markedly the past year, due perhaps, to the low price for wool. The number of hogs has decreased from 25,126 in 1916 to 7,263 in 1921. The number of fowls and bees show substantial increase. A summary of the livestock industry is given in Table 4, which includes only the livestock on project farms.

TABLE 4.—*Number of livestock on the North Platte Reclamation Project during the 11-year period from 1911 to 1921.*

Year.	On hand at the close of the year.							Brought on for feeding.		
	Horses.	Cattle.		Sheep.	Hogs.	Fowls.	Bees (hives).	Sheep.	Cattle.	Horses.
		Beef.	Dairy.							
1911	2,722	2,179		2,000	7,000	2,000	50	25,000	.....	.....
1912	3,329	1,866		2,000	9,123	3,000	80	55,000	.....	.....
1913	3,785	1,640	1,326	5,000	14,286	37,620	315	63,000	3,000	.....
1914	4,618	1,669	1,521	605	22,143	43,898	476	75,000	4,700	700
1915	5,910	4,723	2,218	2,254	24,928	46,971	630	83,000	3,000	500
1916	6,398	5,010	3,040	1,401	25,123	59,249	764	83,500	4,600	500
1917	6,800	6,035	3,345	1,000	16,550	56,015	517	80,000	5,400	500
1918	7,732	5,100	3,400	3,700	15,250	61,800	632	28,000	4,200	800
1919	7,427	4,000	3,500	3,500	11,200	65,480	651	56,000	5,300	200
1920	7,360	6,500		1,100	7,000	64,000	640	39,000	5,000	200
1921	6,894	4,705	2,902	1,416	7,263	72,597	636	12,488	2,183	.....

HOG RAISING.

The decrease in the hog industry is probably due to the high price of corn that prevailed during 1918, 1919, and 1920. With high-priced corn even the alfalfa pasture could not replace enough expensive feed to show a profit. Now that the prices of corn and other grains are comparatively low, the hog industry should soon recover. Under normal conditions the irrigated section of the North Platte Valley with its abundance of alfalfa pasture and its more favorable farrowing season competes very favorably with the Corn Belt in raising hogs.

Hogs and dairy cows go well together. Skim milk is especially valuable for pigs just after being weaned or for growing shotes during the winter. It can even be fed to shotes on alfalfa pasture to very good advantage.

DAIRYING.

The North Platte Valley is and promises to be for some time to come essentially a potato and sugar-beet producing section, with the alfalfa crop as a means of keeping up the productiveness of the land. This system of farming requires a large amount of labor during the summer months with little or nothing to do during the winter months. If the farmer could supplement this type of farming with something

that would furnish him with employment during the winter months with even a moderate return for his labor and furnish a market for his surplus hay and incidentally produce manure for the farm he would find it much to his advantage financially. For those who are able to stand financial losses during the bad years, lamb feeding fits in well with such a system. The dairy cow is another possibility. There is perhaps less risk of financial loss with a small herd of dairy cows than with any other form of livestock.

Where the dairy cow is used the herds should usually be small, so that during the busy crop season the farmer will not have to neglect his field work in caring for the cows. Where the herd is too large either the cows or the crops will be neglected. The farmers who keep their dairy herds down to a number that they can handle in connection with regular field work are the ones who are making the most profit from their operations. Only under very rare circumstances is a farmer justified in keeping the number of cows that will make it necessary for him to hire extra help in caring for them.

While the local dairy industry has been encouraged, it does not seem to be on the increase, at least in number of cows. Perhaps the quality of the cows is improving somewhat, but it is very doubtful whether the quality of the dairy stock that is produced is improving as it should. The great majority of the dairy cows are not bred to suitable dairy sires. As most dairy cows are owned in small herds, the bull cost per cow, should the farmer attempt to own a suitable bull, is prohibitive. It is doubtful whether any real progress in developing the dairy industry will be made until the farmer who has only a few cows can have access to a good dairy bull at moderate cost. This need might be met by means of a cooperative bull association. In associations of this nature service by bulls of the highest class can be had in herds of the smallest size, at an expense per cow lower than any single owner can ordinarily hope to attain. In too many cases under the present conditions good dairy cows are bred either to scrub bulls or to bulls of beef type used for the sole purpose of making the cow freshen.

It is becoming evident that the farmers who, in connection with their potato and beet growing, keep a few cows, a small herd of hogs, and a flock of hens, survive the financial depressions better than those who follow a strictly crop-growing system.

SHEEP FEEDING.

Sheep feeders lost heavily in 1920. The number of lambs that were on feed in 1920 was 39,000, as compared with 56,000 in 1919. With all of the uncertainties still facing them, even though feed was below pre-war prices, few had the hardihood to attempt it again during the winter of 1921–22. Only 12,000 lambs were brought on the project for this season. These were purchased at $5.25 to $8 per 100 pounds, and from present indications they will make a profit. In addition to these, the Great Western Sugar Co. has been feeding 30,000 lambs on wet pulp at the Mitchell plant, 12,000 at Bayard, and 34,000 at Gering.

CATTLE FEEDING.

Cattle feeding in most cases proved very unprofitable during 1920 and 1921. Many feeders had decided not to feed cattle during the

winter of 1921–22, but as the price of feeders was so low and beet tops and hay were so cheap, many changed their minds and a number of cattle were brought on to the project and fed a ration of hay and beet tops for 60 or 90 days and then shipped to Missouri River points, where many of them were bought by Corn Belt farmers for finishing. In most cases the project farmers realized some profit on the transaction. In addition to these cattle fed by farmers a large number were also fed on wet pulp and hay at the Scottsbluff sugar factory.

ALFALFA.

The acreage of alfalfa on the project in 1921 is the lowest it has been since 1913, while the total yield is the lowest since 1912. This is due chiefly to the damage done by grasshoppers to young alfalfa. In 1918 and 1919 grasshoppers destroyed most of the new crop. While the grasshoppers have not been so troublesome during the summers of 1920 and 1921, they have done some damage to young alfalfa, especially to fall-seeded alfalfa. Much of the alfalfa seeded in the spring of 1921 died out from a lack of moisture during the period of drought and the break in the canal.

THE WORK OF THE EXPERIMENT FARM.

The Scottsbluff Experiment Farm is located on the North Platte Reclamation Project, 6 miles east of Mitchell and about 8 miles northwest of Scottsbluff, Nebr., and is supported cooperatively by the United States Department of Agriculture and the University of Nebraska. The farm includes 160 acres of irrigable land, but a part of it is used without irrigation for dry-land experiments. In addition to this farm there is a dry-land pasture of 800 acres which lies above the irrigable lands of the project and is representative of the range lands that surround the project.

The arrangement of the fields of the experiment farm for the years covered by the present report is shown in Figures 1 and 2.

EXPERIMENTS WITH SUGAR BEETS.

IMPORTANCE OF CROP ROTATION.

In the irrigated rotation experiments there are 19 quarter-acre plats of sugar beets grown in 17 different rotations. Fourteen of these rotations have been under way since 1912, while the other three were begun in the spring of 1920. The yields from the 14 rotations are here discussed. On one plat beets are grown continuously, the 1921 crop being the tenth consecutive beet crop. There are five 2-year, three 3-year, two 4-year, and three 6-year rotations. Two of the 2-year and one each of the 3-year and 6-year rotations receive manure at the rate of 12 tons per acre once in the rotation period. In three of the manured rotations sugar beets follow the manure, while in one 2-year rotation they follow potatoes that have been manured. In two rotations sugar beets follow alfalfa the second year after the alfalfa sod is plowed, and in three rotations they follow alfalfa the third season. One of the rotations where sugar beets follow alfalfa the third season also receives manure and is reported in the table as a manured plat. In these different rotations sugar beets follow spring wheat, oats, and potatoes.

In the first years of the experiment sugar beets following potatoes gave much higher yields than those following oats. This difference, however, has gradually decreased until sugar beets following oats now yield more than those following potatoes. On good lands sugar beets follow potatoes with good results, but poor, run-out land can not be improved for sugar beets by growing potatoes on it. Barnyard manure and the residual effect of alfalfa stiumlate the growth of sugar beets, as is shown in Table 5, which gives nine years' results.

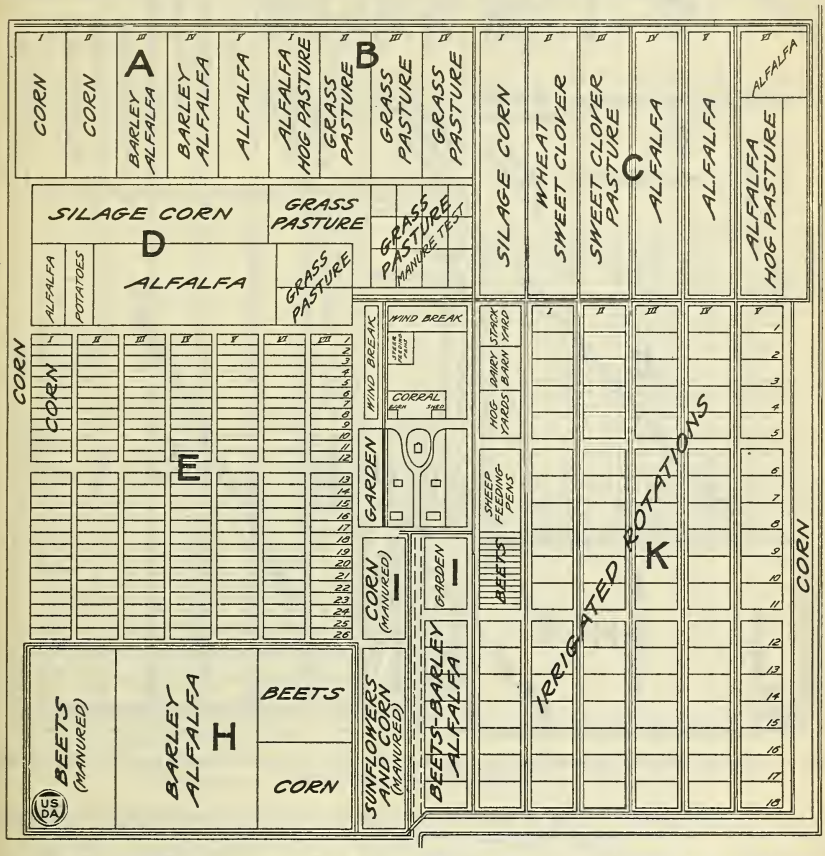

FIG. 1.—Diagram showing the arrangement of the fields and the location of the experiments in 1920 on the Scottsbluff Experiment Farm.

The beet crop in 1916 was damaged by hail and is omitted from the table.

As shown in Table 5, the increase due to the effect of manure has varied from 9.56 tons in 1918 to 3.3 tons in 1912, with a 9-year average of 5.94 tons per acre. These plats are manured at the rate of 12 tons per acre. On this basis each ton of manure increased the beet yield 0.5 of a ton, or the equivalent of $2.50 when $1 a ton is allowed out of $6 for hauling the extra tonnage of beets.

The increase due to the residual effect of the alfalfa has varied from 8.25 tons in 1919 to 2.26 tons in 1921, with a 7-year average of

5.73 tons per acre. The residual effect of alfalfa even during the second and third seasons after it was plowed up amounted, during a 7-year period, to a net increase of $28.65 per acre when beets are valued at $6 per ton.

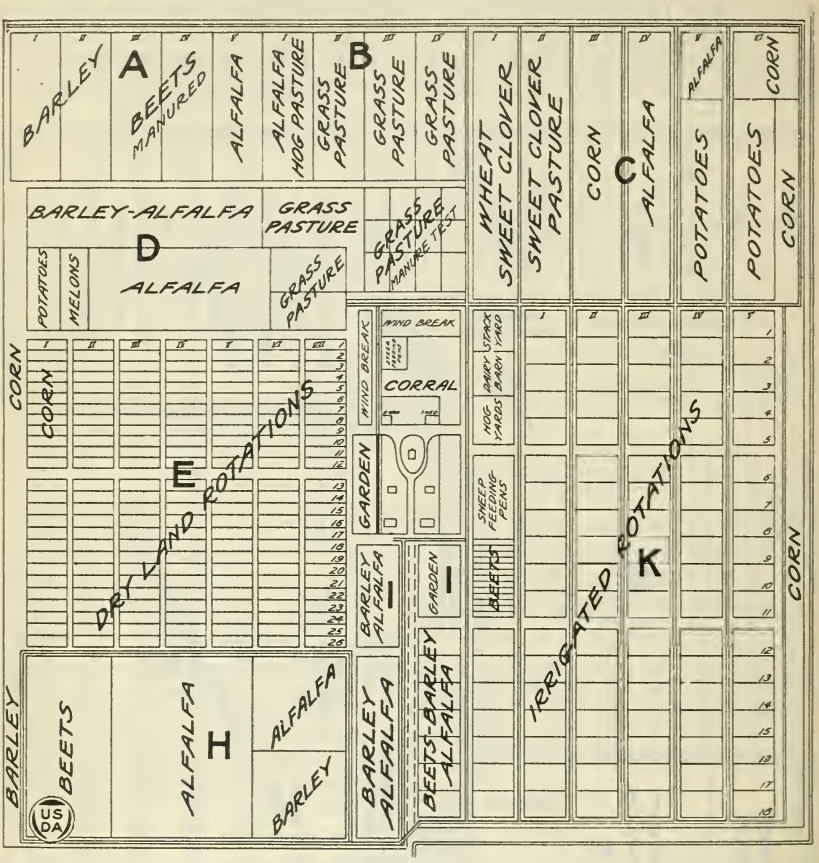

FIG. 2.—Diagram showing the arrangement of the fields and the location of the experiments in 1921 on the Scottsbluff Experiment Farm.

TABLE 5.—*Comparative effect of manure and alfalfa on yield of sugar beets on the Scottsbluff Experiment Farm from 1912 to 1921.*

[Tons per acre.]

Year.	Check, 6 plats.	Manured, 4 plats.	Alfalfa, 4 plats.	Increase in favor of—	
				Manure.	Alfalfa.
1912	17.79	21.09	.....	3.30	.....
1913	17.01	22.87	.....	5.87	.....
1914	14.39	18.26	20.92	3.87	6.53
1915	10.73	14.67	14.76	3.94	4.03
1917	11.09	17.16	15.76	6.07	4.67
1918	11.99	21.55	20.08	9.56	8.09
1919	8.13	15.76	16.38	7.63	8.25
1920	6.57	14.08	13.56	7.51	6.99
1921	9.66	15.41	11.92	5.75	2.26
Average	11.93	17.87	16.20	5.94	5.83

The question naturally arises as to whether it will be possible to maintain high yields of beets even with the occasional use of alfalfa or manure or both in the rotation. During the 10 years of the present experiment the yield of beets on all plats has declined somewhat, though the fluctuations from year to year owing to climatic conditions have been very great.

If the yields of beets as shown in Table 5 are summarized by 3-year periods, again omitting the crop of 1916, the effect of seasonal fluctuations may be partially eliminated. Such a summary is shown in Table 6.

TABLE 6.—*Summary by 3-year periods of the yields of sugar beets from the irrigated rotations, Scottsbluff Experiment Farm, 1912 to 1921, omitting 1916.*

Years.	Average yield per acre (tons).				
	Check, 6 plats.	Manured, 4 plats.	Alfalfa, 4 plats.	Increase in favor of—	
				Manure.	Alfalfa.
1912 to 1914	16.40	20.74	0	4.34	0
1915 to 1918	11.27	17.79	16.50	6.52	5.23
1919 to 1921	8.12	15.08	13.95	6.96	5.83
General average	11.93	17.87	15.23	5.94	5.53

It will be seen from Table 6 that there has been a marked decrease in the yields from the rotations having neither manure nor alfalfa plats. The yield from these check plats during the last three years was not quite half as much as during the first three years. Even the yields from the manured and alfalfa plats show a gradual decrease. It may seem from these yields that even manure or alfalfa will not keep up the high yield of sugar beets, but this decrease in yield may be due more or less to seasonal variations. The summer of 1918 was very favorable for beets and, as shown by Table 5, the yields from the manured and alfalfa plats were practically as high as for the first years of the experiment.

PRACTICAL APPLICATION OF EXPERIMENTAL RESULTS.

The sugar-beet crop of 1921 was not very profitable, especially from the standpoint of the landowner. His returns per acre were virtually cut in two, while his taxes and water charges were greatly increased. Many landowners, particularly those who have rented their farms and moved to town, are beginning to realize that a one-crop system of beets where no manure is used is not always profitable. Fields that have been cropped continuously to beets for the past seven or eight years are too common. When the price for beets was high and the taxes were low, even this type of farming returned a profit, but with a low price for beets and taxes unusually high, the rental in many cases is not sufficient to cover taxes and water charges.

One reason for this one-crop system is that most of these farms are rented to Russian or Japanese farmers, who as a rule are good beet farmers but do not take kindly to other crops. The better class of these beet farmers make money because they rent farms on which

there is a large acreage of alfalfa ready to be broken out. They crop this alfalfa land to beets three or four years and then move to another farm with a large acreage of alfalfa. If the landowner at this point would seed his land back to alfalfa instead of again renting it for beets, and in most cases to a poorer farmer, this method of cropping would not be so objectionable. The second farmer usually grows two crops of beets and then moves on, making room for a third and still poorer beet farmer. The first of these farmers makes money; the second just about breaks even, while the third loses money. With a low price for beets, together with high taxes, the landowner's profits are even less than those of the grower. Where manure is not available it would be to the advantage of both grower and owner if the land were seeded back to alfalfa after being cropped to beets three or four years. A better practice would be to adopt a crop-rotation system in which the same acreage of the different crops is grown every year. If 10 or 20 acres of alfalfa are plowed up, the same acreage should be seeded down. Under such a cropping system the beet acreage must be less. With fewer beets, the tenant naturally will give more attention to other crops. There is no reason why a good beet grower can not become a good grower of potatoes and alfalfa.

Any one crop rotation system will not suit all farms. There is one crop, however, that should be included in every rotation regardless of conditions and that is a legume crop, such as alfalfa or sweet clover. The proportion of other crops will vary under different conditions on different farms. The following is a 7-year rotation which might be used to advantage on many farms:

A 7-year rotation recommended by the Scottsbluff Experiment Farm.

Year.	No. of field.						
	1	2	3	4	5	6	7
1915	Barley, alfalfa.	1-year alfalfa.	2-year alfalfa.	3-year alfalfa.	Potatoes	Beets	Manure, beets.
1916	1-year alfalfa.	2-year alfalfa.	3-year alfalfa.	Potatoes	Beets	Manure, beets.	Barley, alfalfa.
1917	2-year alfalfa.	3-year alfalfa.	Potatoes	Beets	Manure, beets.	Barley, alfalfa.	1-year alfalfa.
1918	3-year alfalfa.	Potatoes	Beets	Manure, beets.	Barley, alfalfa.	1-year alfalfa.	2-year alfalfa.
1919	Potatoes	Beets	Manure, beets.	Barley, alfalfa.	1-year alfalfa.	2-year alfalfa.	3-year alfalfa.
1920	Beets	Manure, beets.	Barley, alfalfa.	1-year alfalfa.	2-year alfalfa.	3-year alfalfa.	Potatoes.
1921	Manure, beets.	Barley, alfalfa.	1-year alfalfa.	2-year alfalfa.	3-year alfalfa.	Potatoes	Beets.
1922	Barley, alfalfa.	1-year alfalfa.	2-year alfalfa.	3-year alfalfa.	Potatoes	Beets	Manure, beets.

It will be seen from this diagram that there are as many fields as there are crops in the rotation and that when this rotation is applied to an 80-acre farm in which 3 acres are used for the farmstead, there will be seven 11-acre fields cropped, as follows: Eleven acres of barley seeded with alfalfa; 11 acres of 1-year-old alfalfa, 11 of 2-year-old alfalfa, 11 of 3-year-old alfalfa, 11 of potatoes, 11 of beets, and 11 of beets with manure.

In this rotation there are two cash crops, beets and potatoes, and two feed crops, alfalfa and barley. If the alfalfa and straw

from the barley crops are used on the farm it will furnish manure for the 11 acres of second-year beets.

Table 7 shows the probable returns from 77 acres of continuous beets and from 77 acres on which the above 7-year rotation is conducted.

TABLE 7.—*Probable returns from a farm continuously cropped to beets as compared with probable returns from a 7-year rotation.*

Crops.	Number of acres.	Acre yield.	Unit price.	Tenant's share.	Owner's share.	Grower and owner.
Continuous beet system:						
Beets	77	9 tons	$5.00	$2,772.00	$693.00	$3,465.00
Average returns per acre				36.00	9.00	45.00
7-year rotation system:						
Barley-alfalfa	11	60 bushels	.40	176.00	88.00	264.00
Alfalfa	33	4 tons	5.00	330.00	330.00	660.00
Potatoes	11	250 bushels	.50	1,031.25	343.75	1,375.00
Beets	22	15 tons	5.00	1,320.00	330.00	1,650.00
Total				2,857.25	1,091.75	3,949.00
Average returns per acre				37.11	14.17	51.28

As will be seen by comparing the continuous beets with the 7-year rotation as shown in the above table, the returns for all concerned are higher from the rotation system.

There is less risk in a rotation system than in a one-crop system. It seldom happens that a season is unfavorable to all crops. Usually the yield or price of some one crop is above the average. The past two years illustrates this point. In 1920 beets were more profitable than potatoes, while in 1921 the reverse was true. Had the beet farmers in 1921 put in a few acres of potatoes they would have realized a larger return per acre than from the beets. In 1921 the landowner's share of a 15-ton yield of beets was $21 per acre, while from a 250-bushel yield of potatoes it was about $50 per acre. In 1920 the difference was in favor of beets.

PLOWING COMPARED WITH DISKING BEET LAND FOR BEETS.

Sometimes the spring is very backward; it is either cold or wet, making field work impossible. In the spring of 1920 most beet land was prepared after May 1. During a backward spring it is impossible in many cases to prepare the land, especially if it is spring plowed, so that beets can be planted as early as they should be. As a rule, beets planted the last 10 days in April will yield much more than beets planted after the middle of May. Land can be prepared much faster by disking than by plowing. As the beet puller gives the soil a good stirring at harvest time, it is questionable whether this land can not be put in as good shape for another crop of beets by a thorough disking rather than plowing. To get some data along this line tests have been conducted during the past two seasons. Eight plats were used in this test each year. Four plats were plowed and four were double-disked. The plowing and disking were done in the spring just before planting. The land had been in beets the previous year. The yields of sugar beets when grown on plowed beet land and disked beet land at the Scottsbluff Experiment Farm in 1921 are shown in Table 8.

TABLE 8.—*Yields of sugar beets when grown on plowed beet land and disked beet land at the Scottsbluff Experiment Farm in 1920 and 1921.*

Yield (tons per acre).	Plowed plats.		Disked plats.	
	1920	1921	1920	1921
Maximum	10.88	16.55	9.89	15.81
Minimum	9.84	13.82	8.52	14.18
Mean	10.29	15.18	9.15	15.03
Increase in favor of plowed plats	1.14	.15	.....	.....

The average yield from the plowed plats was a little higher than from the disked plats in both years. This difference amounted to 1.14 tons in 1920 and 0.15 ton in 1921, or an average for the two years of a little less than two-thirds of a ton per acre. In a year when the spring is backward if the beets can be planted a week or 10 days earlier by disking than by plowing it is perhaps advisable to disk, for the advantage gained in earlier planting will more than make up for the difference in favor of plowing. The land should be thoroughly disked. Poor disking would be as bad as, if not worse than poor plowing. Weeds are more troublesome on disked land than on plowed land.

TIME OF PLANTING SUGAR BEETS.

From results secured from a test conducted during the summer of 1920 it is clear that many farmers make a mistake by postponing planting sugar beets after the land is prepared. Where a large acreage is to be planted, it is better to prepare 10 or 12 acres and plant it and then prepare 10 or 12 acres more, planting it at once and so on, until the whole field is planted, rather than to prepare it all before any planting is done. Where planting is delayed two or three weeks after the land is prepared, weeds become more troublesome, for in many cases the weeds are already coming up when the beets are planted. Delayed planting, especially if it is rather late in the season, allows the land to dry out before the seed is put in. Another reason why all beets should not be planted at the same time is that they will all be ready to thin at the same time. An average of three-years' tests show that 20 days of delayed thinning reduced the yield more than 5 tons per acre. The effect of delayed planting is shown in Table 9, which reports the tonnage per acre. Except in the time of plowing, these plats received the same treatment.

TABLE 9.—*Effect of delayed planting after land is plowed on yield of sugar beets at the Scottsbluff Experiment Farm in 1921.*

Time of planting.	Yield in tons per acre.	Time of planting.	Yield in tons per acre.
Planted 4 weeks after plowing	10.57	Planted 2 weeks after plowing	12.53
Planted 3 weeks after plowing	11.33	Planted the next day after plowing	14.30

Where beets were planted four weeks after the land was prepared the yield was 3.73 tons per acre less than where the planting was made the next day after the land was prepared.

EFFECT OF BARNYARD MANURE AND COMMERCIAL FERTILIZERS ON YIELDS OF SUGAR BEETS.

In this experiment different amounts of barnyard manure, bone meal, dried blood, and a combination of the three were used in growing sugar beets. The test was conducted on 39 plats in field F–I. This series of plats is made up of 13 sets of plats in triplicate. Two of these sets, or six plats, were checks which received no manurial treatment. The test began in the spring of 1917.

In 1917 five sets of plats received barnyard manure at the rate of 12, 24, 36, 48, and 60 tons per acre; bone meal was applied to two sets of plats at the rate of 300 pounds and 600 pounds; dried blood was applied to two sets of plats at the rate of 200 pounds and 400 pounds; also bone meal and dried blood were both applied at the rate of 300 pounds and 200 pounds, respectively, to one set of plats, and the same fertilizers were applied at the rate of 600 pounds of bone meal and 400 pounds of dried blood to another set of plats.

No commercial fertilizers were used except the first year, but in 1918 and 1919 manure was applied at the same rate as in 1917 to one plat and to two plats, respectively, in each of the five sets manured the first year. Also manure was applied at the rate of 24 tons per acre to one plat in 1918 and to two plats in 1919 of each of the sets that received commercial fertilizers in 1917. Of all the manured or fertilized plats, 22 received no additional applications in 1918, and 11 plats received no additional applications in either 1918 or in 1919. No additional manure was applied in 1920 or in 1921. The stand of beets in 1919 was very ununiform and the yields are not reported. Table 10 shows the kind and amount of manure or fertilizers used and the yields obtained per year, all expressed in terms of tons per acre.

TABLE 10.—*Treatment of plats and yields of beets from fertilizing tests at the Scottsbluff Experiment Farm for the years 1917 to 1921, inclusive.*

[Plats 1 and 7 are check plats. M=manure, in tons; BM=bone meal, in pounds; DB=dried blood, in pounds.]

Plat No.	Date.	Series I.		Series II.		Series III.	
		Fertilizer used, per acre.	Yield (tons).	Fertilizer used, per acre.	Yield (tons).	Fertilizer used, per acre.	Yield (tons).
1 (check plat)	1917	None	16.08	None	15.27	None	14.69
	1918		18.52		19.89		17.81
	1919		.....		.....		.....
	1920		11.24		10.73		10.52
	1921		13.32		14.62		14.62
2	1917	12 M	17.22	12 M	18.68	12 M	18.05
	1918	12 M	19.11	.....	21.52	.....	19.63
	1919	12 M	.....	12 M	.....	.....	.....
	1920	.....	14.63	.....	15.54	.....	13.52
	1921	.....	13.65	.....	14.95	.....	14.62
3	1917	24 M	19.26	24 M	18.20	24 M	17.98
	1918	24 M	23.46	.....	21.78	.....	20.93
	1919	24 M	.....	24 M	.....	.....	.....
	1920	.....	17.94	.....	16.12	.....	13.58
	1921	.....	18.20	.....	17.87	.....	16.56

TABLE 10.—*Treatment of plats and yields of beets from fertilizing tests at the Scottsbluff Experiment Farm for the years 1917 to 1921, inclusive*—Continued.

Plat No.	Date.	Series I.		Series II.		Series III.	
		Fertilizer used, per acre.	Yield (tons).	Fertilizer used, per acre.	Yield (tons).	Fertilizer used, per acre.	Yield (tons).
4	1917	36 M	18.20	36 M	18.46	36 M	17.12
	1918	36 M	24.11		24.24		2.36
	1919	36 M		36 M			
	1920		16.45		15.14		13.06
	1921		17.23		18.20		15.26
5	1917	48 M	19.27	48 M	17.55	48 M	17.38
	1918	48 M	26.21		23.01		21.25
	1919	48 M		48 M			
	1920		17.55		17.10		13.32
	1921		18.20		17.23		14.62
6	1917	60 M	19.32	60 M	18.52	60 M	19.01
	1918	60 M	25.95		23.66		18.53
	1919	60 M		60 M			
	1920		19.70		19.05		15.08
	1921		21.12		19.82		15.60
7 (check plat)	1917		15.44		13.15		14.53
	1918		21.33		19.63		18.79
	1919						
	1920		15.02		13.20		10.98
	1921		15.60		15.60		14.95
8	1917	300 BM	16.51	300 BM	16.64	300 BM	14.56
	1918	24 M	24.76		21.48		20.15
	1919	24 M		24 M			
	1920		18.52		15.08		12.93
	1921		17.23		16.90		14.62
9	1917	600 BM	16.97	600 BM	15.92	600 BM	15.60
	1918	24 M	23.78		21.84		18.73
	1919	24 M		24 M			
	1920		18.36		16.76		12.81
	1921		17.86		18.54		15.26
10	1917	300 BM 200 DB	15.62	300 BM 200 DB	14.69	300 BM 200 DB	15.21
	1918	24 M	23.72		19.99		21.25
	1919	24 M		24 M			
	1920		16.05		14.50		11.76
	1921		19.16		19.16		16.25
11	1917	600 BM 400 DB	16.25	600 BM 400 DB	16.97	600 BM 400 DB	17.05
	1918	24 M	24.89		23.53		23.34
	1919	24 M		24 M			
	1920		16.36		15.74		12.55
	1921		20.15		19.15		16.56
12	1917	200 DB	15.85	200 DB	16.50	200 DB	16.20
	1918	24 M	24.11		23.14		22.62
	1919	24 M		24 M			
	1920		16.44		16.90		14.17
	1921		20.15		16.56		15.60
13	1917	400 DB	14.82	400 DB	14.62	400 DB	16.72
	1918	24 M	23.01		23.91		20 21
	1919	24 M		24 M			
	1920		12.28		14.90		11.50
	1921		18.85		16.56		16.56

Table 11 is a summary of Table 10. This table gives the kind and total amount of manure and fertilizers that have been applied to each plat, the four-year average yield, and the amount of increase due to the manurial treatment.

TABLE 11.—*The four-year average yield of sugar beets from plats receiving different amounts and kinds of commercial fertilizers and barnyard manure at the Scottsbluff Experiment Farm, 1917, 1918, 1920, and 1921.*

Plat No.	Item.	Series I.	Series II.	Series III.
2	Manure applied per acre.....tons..	36.0	24.0	12.0
	Average yield per acre.....do....	16.1	17.6	16.4
	Increase over check plats.....do....	.9	2.4	1.2
3	Manure applied per acre.....do....	72.0	48.0	24.0
	Average yield per acre.....do....	19.7	18.5	17.3
	Increase over check plats.....do....	4.5	3.3	2.1
4	Manure applied per acre.....do....	108.0	72.0	36.0
	Average yield per acre.....do....	19.0	19.0	17.0
	Increase over check plats.....do....	3.8	3.8	1.8
5	Manure applied per acre.....do....	144.0	96.0	48.0
	Average yield per acre.....do....	20.3	18.7	16.6
	Increase over check plats.....do....	5.1	3.5	1.4
6	Manure applied per acre.....do....	180.0	120.0	60.0
	Average yield per acre.....do....	21.5	20.2	17.0
	Increase over check plats.....do....	6.3	5.0	1.8
8	Manure and fertilizer applied:			
	Manure per acre.....tons..	48.0	24.0	.....
	Bone meal per acre.....pounds..	300.0	300.0	300.0
	Average yield per acre.....tons..	19.2	17.5	15.5
	Increase over check plats.....do....	4.0	2.3	0.3
9	Manure and fertilizer applied:			
	Manure per acre.....tons..	48.0	24.0	.....
	Bone meal per acre.....pounds..	600.0	600.0	600.0
	Average yield per acre.....tons..	19.2	18.2	15.6
	Increase over check plats.....do....	4.0	3.0	.4
10	Manure and fertilizer applied:			
	Manure per acre.....tons..	48.0	24.0	.....
	Bone meal per acre.....pounds..	300.0	300.0	300.0
	Dried blood per acre.....do....	200.0	200.0	200.0
	Average yield per acre.....tons..	18.6	17.1	16.1
	Increase over check plats.....do....	3.4	1.9	.9
11	Manure and fertilizer applied:			
	Manure per acre.....tons..	48.0	24.0	.....
	Bone meal per acre.....pounds..	600.0	600.0	600.0
	Dried blood per acre.....do....	400.0	400.0	400.0
	Average yield per acre.....tons..	19.4	18.8	17.3
	Increase over check plats.....do....	4.2	3.6	2.1
12	Manure and fertilizer applied:			
	Manure per acre.....tons..	48.0	24.0	.....
	Dried blood per acre.....pounds..	200.0	200.0	200.0
	Average yield per acre.....tons..	19.1	18.3	17.1
	Increase over check plats.....do....	3.9	3.1	1.9
13	Manure and fertilizer applied:			
	Manure per acre.....tons..	48.0	24.0	.....
	Dried blood per acre.....pounds..	400.0	400.0	400.0
	Average yield per acre.....tons..	17.2	17.5	16.2
	Increase over check plats.....do....	2.0	2.3	1.0

The plats receiving manure show a marked increase in yield. The immediate increase, however, is not in proportion to the quantity of manure applied. From the yields secured in 1920 and 1921 from plats that have not received any additional manure since the spring of 1919, it is shown that the residual effect is much greater from the heavy applications than from the light applications. In 1917, when 12 tons of manure were applied, the increase in yield was 3.1 tons per acre; when 60 tons of manure were applied the increase was 4.1 tons per acre. Had the 60 tons of manure been applied to 5 acres instead of 1, the increase in yield of beets due to this same quantity of manure would have been 15.5 tons instead of 4.1 tons. The lasting benefit, however, is much greater from the heavy applications. By using the

average yield from the three No. 1 plats as a check the yields for 1921, as recorded in Table 10, show that the residual effect from all the 12-ton applications on plat No. 2 increased the average yield 0.2 ton per acre, while the residual effect of all the 60-ton applications on plats No. 6 increased the average yield 4.6 tons per acre. It would seem from these results that where the supply of manure is limited, and this is the case on most farms, and when immediate results are desired, it is better to apply it at the rate of 10 or 12 tons per acre rather than in heavier applications, but in cases where there is an abundance of manure heavy applications are advisable. The residual effects of different quantities of manure is also shown in Table 12.

TABLE 12.—*Residual effect of manure applied in 1917, 1918, and 1919 on the yield of sugar beets in 1920 and 1921 at the Scottsbluff Experiment Farm.*

Items of comparison.	Manure applied.				
	Part 1.			Part 2.	
	1917, 1918, and 1919	1917 and 1919	1917	1918 and 1919	1919
1920–21.					
Total manure applied per acre.....tons..	108.0	72.0	36.0	48.0	24.0
Number of plats.....	5	5	5	6	6
2-year average yield per acre.....tons..	17.5	17.1	14.5	17.6	16.7
Yield from 6 check plats, 2-year average, per acre .....tons..	13.4	13.4	13.4	14.2	14.2
Residual effect of manure, 2-year average.....	4.1	3.7	1.1	3.4	2.5
1921.					
Yield per acre.....tons..	17.7	17.7	15.3	18.9	17.8
Average yield from 6 check plats.....do....	14.8	14.8	14.8	15.8	15.8
Residual effect of manure.....	2.9	2.9	.5	3.1	2.0

The plats treated with commercial fertilizers show a slight increase, but this increase is not so marked as where barnyard manure was used. The average yields from the check plats and from those severally treated with barnyard manure and commercial fertilizers for each of the four years are given in Table 13.

TABLE 13.—*Effect of the use of commercial fertilizers and barnyard manure on the yield of sugar beets grown on the Scottsbluff Experiment Farm in 1917, 1918, 1920, and 1921.*

Treatment of plats.	Number of plats.	Average yield per acre (tons).	
		Actual.	Increase.
Season of 1917:			
Check (no fertilizer).....	6	14.86	.....
Barnyard manure.....	15	18.28	3.42
Commercial fertilizers.....	18	15.96	1.10
Season of 1918:			
Check (no fertilizer).....	6	19.4	.....
Barnyard manure in 1917.....	10	21.8	2.4
Barnyard manure in 1917 and 1918.....	5	23.8	4.4
Commercial fertilizers in 1917, manured in 1918.....	6	24.0	4.6
Commercial fertilizer in 1917.....	12	21.4	2.0
Season of 1920:			
Check (no fertilizer).....	6	11.44	.....
Barnyard manure in 1917.....	5	13.71	2.27
Barnyard manure in 1917 and 1919.....	5	16.59	5.15
Barnyard manure in 1917, 1918, and 1919.....	5	17.26	5.82
Commercial fertilizer in 1917, manured in 1918 and 1919.....	6	16.33	4.88
Commercial fertilizer in 1917, manured in 1919.....	6	15.63	4.19
Commercial fertilizer in 1917.....	6	12.53	1.09
Season of 1921:			
Check (no fertilizer).....	6	14.78	.....
Barnyard manure in 1917.....	5	15.33	.65
Barnyard manure in 1917 and in 1919.....	5	17.61	2.83
Barnyard manure in 1917, 1918, and 1919.....	5	17.68	2.90
Commercial fertilizer in 1917, manured in 1918 and 1919.....	6	18.90	4.14
Commercial fertilizer in 1917, manured in 1919.....	6	18.14	3.36
Commercial fertilizer in 1917.....	6	15.81	1.03

EXPERIMENTS WITH POTATOES.

EFFECT OF CROP ROTATION AND MANURE.

In the irrigated rotation experiments potatoes are grown in 15 different crop rotations, 13 of which have now been under way since 1912, while the other 2 were inaugurated in the spring of 1920. Of these 13 potato plats 1 is a continuous-crop plat, potatoes having been grown on this same plat every season for the past 10 years. There are six 2-year, two 3-year, two 4-year, and two 6-year rotations. Two of the 2-year rotations, one of the 3-year, and one of the 6-year rotations receive manure at the rate of 12 tons per acre. In the 2-year rotation potatoes follow manure the first year; in the 3-year rotation they follow manure the second year; and in the 6-year rotation they follow manure the fifth year. In the different rotations potatoes follow corn, oats, beets, and alfalfa. With the exception of the difference in crops and the application of manure, all of these 13 potato plats receive the same treatment. They are planted at the same time, cultivated and irrigated the same, and the same kind of seed is used on all plats. Any difference in yield, therefore, must be due chiefly to the effect of the preceding crops or the effect of manure.

Beginning with the second year there has been a marked difference in the yield of these different plats. During the early part of the experiments potatoes following beets gave very much higher yields than the potatoes following oats or corn. Where potatoes followed beets without manure the yield was higher than where potatoes followed oats with manure. In fact the potatoes following beets yielded almost as high as where they followed alfalfa. But this spread between the potatoes following beets and those following oats has not been maintained. The spread has gradually decreased until, in 1920, potatoes following oats in every case outyielded potatoes following beets.

It is often said that potatoes put the land in good shape for beets and that beets put the land in good shape for potatoes. This is true only under one condition and that is that the land is good to begin with. It is impossible to put worn-out land in good condition for potatoes by growing beets on it or to put it in good shape for beets by growing potatoes on it. There is only one kind of plant that can be grown on worn-out land that will improve it for succeeding crops and that is a legume, such as alfalfa or clover. A leguminous plant has the power of taking nitrogen from the air and using it in its growth, so that when it is plowed and the roots decay this nitrogen in the roots becomes available for succeeding crops. No other plants have this power. They must depend entirely for their nitrogen requirements on the supply already in the soil. The highest yields of potatoes were obtained from plats following alfalfa. The potatoes following two years of alfalfa did not give as high yields as where they followed three years of alfalfa.

Manure does not increase the yield of potatoes as much as alfalfa does. In the 2-year rotation manure is applied to the plats at the rate of 12 tons per acre every other year, so that during the past 10 years each of the plats in the 2-year rotations has received 60 tons of manure, or an average of 6 tons per year. This is rather a heavy application, but even then the yields of potatoes were not nearly as

great as from the plats following alfalfa. For the past nine years the potatoes following alfalfa have given an average yield of 280.8 bushels per acre; potatoes following manure, 202.2 bushels, while potatoes grown in rotations not having alfalfa or receiving manure gave an average yield of only 144.4 bushels. (Table 14.) The increased yield of potatoes due to the residual effect of alfalfa has varied from 106.6 bushels per acre in 1916 to 211.3 bushels in 1920, with a 9-year average of 136.4 bushels per acre. The manured plats show an increased yield for the 9-year average of 57.8 bushels per acre. The increase caused by alfalfa was more than twice as much as the increase due to manure.

TABLE 14.—*Effect of manure and the growing of alfalfa on the yields of potatoes on the Scottsbluff Experiment Farm from 1913 to 1921, inclusive.*

Year.	Average yields per acre (bushels).				
	Check, six plats.	Manured, three plats.	Alfalfa land, four plats.	Increase in favor of—	
				Manure.	Alfalfa.
1913	260.8	339.2	376.6	78.4	115.8
1914	149.8	244.6	292.7	94.8	142.9
1915	105.9	156.6	221.2	50.7	115.3
1916	197.8	205.0	304.4	7.2	106.6
1917	139.2	193.6	297.9	54.4	158.7
1918	90.1	115.9	223.2	25.8	133.1
1919	117.1	191.6	236.3	74.5	119.2
1920	129.1	233.0	340.4	103.9	211.3
1921	109.5	140.7	235.0	31.2	125.5
Average	144.4	202.2	280.8	57.8	136.4

The yields from the continuous-crop plats and from the plats in rotations not having alfalfa or receiving manure have decreased until the average yield for the past three years is not more than half the average yield for the first three years. Even the potatoes from the 2-year and 3-year rotations receiving manure show a slight decrease in yield, while the potatoes following alfalfa show an increase.

It would seem from this that the ideal place for potatoes is following alfalfa. Sugar beets do well on manured land. This being true, farmers who have both alfalfa land and manure and who are going to grow both potatoes and beets will find it more profitable to put their potatoes on the alfalfa land and apply the manure to the land for beets.

The rotation not only has a marked effect upon the yield but also on the quality of potatoes. After the first two or three years of the experiments the potatoes grown in the continuous-crop plat and in the 2-year and 3-year rotations were very scabby. Since then no marketable potatoes have been harvested from these short rotations, notwithstanding the fact that the potatoes are all treated with corrosive sublimate before being planted. Potatoes grown in the 4-year rotations are much freer from scab than those grown in the 3-year rotations, while those grown in the 6-year rotations are fairly free from scab.

There is no doubt that the scab disease lives in the soil at least three years and to a less extent four years, but it seems that it dies out before the sixth year. It is true that there is a little scab even

on the potatoes grown in the 6-year rotations, but it is doubtful if this amounts to more than would be on potatoes grown on land that had never been in potatoes before. It sometimes happens that clean potatoes planted on new land after being treated with corrosive sublimate will have some scab. It is possible that this scab germ is carried to the new land by wind or irrigation water. But the amount of scab from this source will be very small compared with the amount that lives over in the soil from one potato crop to the other in short rotations. The effect of the rotation on yield and quality is shown in Figure 3.

It is evident from these results that a farmer in order to keep the scab down to the minimum must plan his rotations so that potatoes will not come on the same land oftener than once in six years. An ideal rotation would be one in which potatoes follow three years of alfalfa with enough other crops included to make a six or seven year rotation.

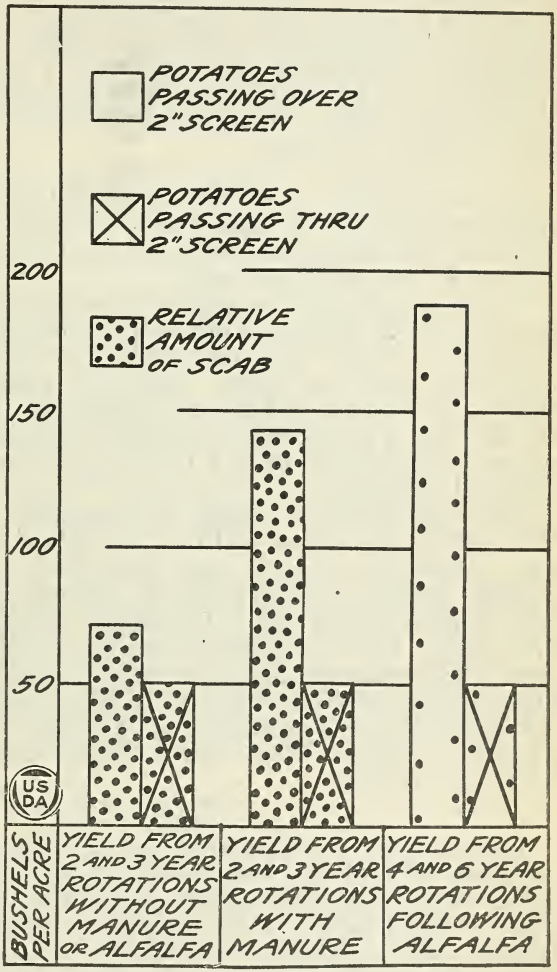

FIG. 3.—Diagram showing the effect of short rotations including and not including manure and long rotations including alfalfa upon yield, size, and prevalence of scab on potatoes on the Scottsbluff Experiment Farm (3-year average, 1919, 1920, and 1921).

POTATO VARIETIES AND CHOICE OF SEED.

The seed used for the rotation plats from 1912 to 1918 was of the Pearl variety. In 1912 dry-land seed was used. The seed used the next six years was hand-picked potatoes from the four alfalfa plats that were grown the previous years. These tubers were of marketable size, true to type, and free from disease. It was thought by using this hand-picked seed that the strain might be improved. For the first year or so the yield and quality of potatoes from this seed was good, but after that the potatoes began to decrease both in quality and yield until at the end of the seventh year they were so badly

run out that they would not have been recognized as belonging to the Pearl variety. In 1919 these Pearls were discarded and dry-land Downings from Idaho were used. These Downings gave very satisfactory yields the first year, but some of them that had been hand-picked from the plats at digging time were planted outside of the rotation plats in 1920. The yields from this first-year irrigated stock were very poor. In fact, it had run out as badly in two years as the Pearls did in seven. In 1920 and 1921 dry-land Triumph seed was used. In both cases the yield and quality of potatoes were very satisfactory except that the stand in 1921 was rather uneven. The yield from the alfalfa plats of 1920 was used by different farmers for planting in 1921. In every case the yield and quality of potatoes from this seed were good.

For some reason it seems that potatoes can not be grown under irrigation year after year with good results. Some strains seem to stand irrigation better than others, but from our experience it does not seem advisable to use seed that has been grown under irrigation more than two or three years.

In growing potatoes the matter of seed is a very important factor. Good seed of an inferior variety will give better results than poor seed of a good variety. It is very difficult to grow a good potato crop from poor seed, no matter what the variety. The question of variety, however, is not to be disregarded. The variety should be (1) the kind of potato that the public demands and (2) one that will mature early enough so that the crop can be harvested before it is damaged by frost.

In the North Platte Valley, the Downing, the Irish Cobbler, the Pearl of the white type, and the Triumph of the red type are giving very satisfactory results when good seed is planted. The Irish Cobbler and the Triumph are the earliest of these varieties. For early market, if they are to be shipped, perhaps the Irish Cobbler is preferable. The Rural New Yorker No. 2 and the King will perhaps yield a little heavier than some of the other varieties, but they are rather late in maturing and are too often damaged by frost. While the Early Ohio is an early-maturing variety, it is not recommended for irrigated land. When grown under irrigation it is usually very rough and knobby.

TIME OF PLANTING.

Tests have been conducted to determine how late it is safe to plant potatoes. The results from these tests show that, as a general rule, the later plantings give smaller yields, but the tubers are of better grade. The difficulty in late planting is to get seed that will grow. If good seed is available, potatoes are perhaps as good as any other crop to plant on the blown-out beet land. In 1917 very good yields were obtained from plantings made as late as July 2. Potatoes planted so late will not mature sufficiently for the general market, but they can be used for seed the following year.

POTATO DISEASES.[2]

Potatoes have many different diseases which cause great losses to the crop every year. In many of these diseases the amount of infection depends upon the environmental conditions. It was with the

[2] This report was prepared by R. W. Goss, assistant plant pathologist of the University of Nebraska, who had direct supervision of this plant-disease work.

purpose of determining the effect of these various environmental factors upon the infection and progress of the disease that the following field experiments were undertaken. During the summer of 1921 work was begun at the Scottsbluff experiment farm for the purpose of studying some of these diseases under both irrigated and dry-land conditions.

Fusarium oxysporum (commonly known as Fusarium wilt or blight).—The object of this test was to compare the pathogenicity of different strains of *F. oxysporum* under both irrigated and dry-land conditions. The work also includes a study of different methods of inoculation in an attempt to determine the method by which the organism gains entrance into the potato under field conditions and also to determine the relation of the callusing of the cut seed pieces to infection of this organism from the soil.

The results show that different degrees of pathogenicity were found among the various strains of *F. oxysporum* tested. Practically no typical wilting of the plants was produced in either of the plats with any of the methods of inoculation and organisms used. The largest amount of infection, as determined by the number of infected tubers produced, was found on the potatoes grown under dry-land conditions. There was apparently no relation between the percentage of infection and the percentage of germination. Apparently there was no correlation between the browning of the vascular system of the stems and the number of infected tubers produced. The greatest amount of infection was obtained by inoculating the seed piece by taking freshly cut tubers and dipping them in a spore suspension of the organism to be tested. The amount of infection seemed to decrease where the cut surface was allowed to callus over before inoculating.

Fusarium (species unidentified).—This organism appears capable of producing a very high percentage of wilted plants under all conditions of the experiments. The pathogenicity of this organism appears to be much greater than that of strains of *F. oxysporum.*

Black-leg and mosaic.—Work was also conducted with the organism causing black-leg of potatoes and also with the mosaic disease of potatoes. These tests were preliminary studies to serve as a basis of future work, which will be reported later.

STRAIN TEST, DISTANCE-OF-PLANTING EXPERIMENT, AND EFFECT OF IRRIGATION ON SEED POTATOES.[3]

The department of horticulture of the Nebraska Agriculture Experiment Station has been conducting some experimental work with potatoes on the Scottsbluff experiment farm. Part of this work was inaugurated in 1920, but most of it was started in 1921. Much of the work is with seed potatoes and is of such a nature that conclusive results will not be obtained until the experiments have been run for several years. Some results are of sufficient interest to warrant a brief statement concerning the various lines of work. More complete details will be reported from time to time as the results justify.

Strain tests of important varieties.—Various lots of potatoes or strains of several of the more important varieties were secured from different States. In each case the strains were considered among the

[3] H. O. Werner, of the department of horticulture of the Nebraska Agricultural Experiment Station, had direct charge of the work and prepared this report.

best in those States. The varieties included were Triumph, Irish Cobbler, Downing, Rural New Yorker, and Russet Rural New Yorker. These were all grown under irrigation on land that was previously in alfalfa.

In the case of the Irish Cobbler, seven strains were obtained from Minnesota, three from Wyoming, one from Michigan, and one from Dawes County, Nebr. These strains produced yields of U. S. Grade No. 1 potatoes that ranged from 97 to 212.7 bushels per acre. The percentage of Grade No. 1 tubers varied from 76.8 to 95.6. The tubers varied from fair to very good type in the various strains. Both the highest and lowest yielding lots were from Minnesota. The two best lots were from Minnesota and northern Michigan. Both have been selected carefully for a period of years. The one lot from Dawes County yielded at the rate of 121.7 bushels per acre. This lot has been given only very ordinary selection and does not represent fairly the possibilities of Irish Cobbler seed potato production in western Nebraska.

Four lots of Downing potatoes from Idaho were grown in comparison with a dry-land lot and an irrigated lot produced in western Nebraska. The Idaho strains varied in yield of U. S. Grade No. 1 potatoes from 80 to 165 bushels per acre. The dry-land strain grown at Hay Springs in Sheridan County in 1920 yielded 133 bushels of Grade No. 1 potatoes. The strain that was grown near Minatare in Scotts Bluff County under irrigation in 1919 and 1920 yielded at the rate of 40 bushels of Grade No. 1 potatoes of rather poor quality. There was considerable variation in the characteristics of the Idaho strain. Some of them are apparently more like the Green Mountain than the Downing type, though all go by the name of Idaho Rural or Charles Downing in Idaho and the other Northwestern States.

The Russet Rural New Yorker, known as the Late Petoskey throughout Michigan, was represented by three selected strains from northern Michigan, one dry-land strain from Kimball County, Nebr., and one irrigated strain from near Minatare in Scotts Bluff County, Nebr. The Michigan lots varied in yield of Grade No. 1 potatoes from 114 to 157 bushels per acre. The dry-land lot from Kimball County produced at the rate of 127 bushels of Grade No. 1 potatoes per acre, and the irrigated lot from Minatare yielded at the rate of 123 bushels of Grade No. 1 potatoes per acre. The irrigated strain of the Russet Rural New Yorker was relatively better than in the case of the Downing. This and other work done in the North Platte Valley leads to the conclusion that the Rural New Yorker varieties do not run out as rapidly under irrigation as do some of the others.

In the case of the Triumph variety 13 strains of western Nebraska certified Triumph potatoes were planted in comparison with 1 dry-land strain from northern Colorado, 4 dry-land strains from Wyoming, and the improved Smith strain from Wisconsin. The Nebraska strains varied in yield of Grade No. 1 potatoes at the rate of from 143 to 235 bushels per acre, and the Wyoming strains ranged from 140 to 200 bushels per acre. The Smith strain from Wisconsin yielded at the rate of 203 bushels per acre of Grade No. 1 potatoes. Four western Nebraska strains yielded at the rate of 200 bushels per acre or more of Grade No. 1 potatoes.

From these strain tests it is quite evident that no one State has a monopoly on good seed potatoes. The quality and yield of potatoes depends very largely upon the selection of the seed, the control of

diseases, and the climatic conditions under which the seed potatoes have been produced.

Distance-of-planting experiment.—The Triumph, Downing, and Russet Rural New Yorker varieties were used in a distance-of-planting experiment on irrigated land. Potatoes of each variety were planted at the following distances in a row: 6, 9, 12, 15, 18, 21, 24, 27, and 30 inches. In the Triumph variety the greatest yields of Grade No. 1 potatoes were secured from the 6 to 12 inch spacings and the lowest yields from the 24 to 30 inch spacings. After deducting the seed potatoes used in each plat the closer spacing still outranked the greater distances by approximately 100 bushels per acre, the net yield of Grade No. 1 potatoes in the 6-inch spacing having been at the rate of 317 bushels per acre with 222 bushels per acre in the 30-inch plat.

The Downing variety produced the most marketable tubers in the 9 to 15 inch plats and the least in the 30-inch plats. The greatest net yields were produced at the 12 and 15 inch spacings.

With the Russet Rural New Yorker variety maximum yields were obtained from the 18-inch spacing. However, it is doubtful if the results with the Russet Rural New Yorker are entirely comparable to the other varieties, as the vines were still very green at digging time.

The weight of the Downing tubers increased gradually from 22.8 pounds per 100 tubers in the 6-inch plat to 45 pounds per 100 tubers in the 30-inch plat.

Apparently potatoes of the Triumph and Downing varieties can be planted most profitably on fertile irrigated soils at distances not to exceed 12 inches apart in the row. It is possible that the rows can be planted closer than is generally the custom. This experiment will be continued for several more years in order to get more complete information on this subject.

Effect of irrigation on seed potatoes.—Several tuber strains of Triumph potatoes that were grown on a farm north of Minatare for from one to three years were planted on the experiment farm in 1921. These strains had been grown under irrigation one, two, and three years. They were planted in comparison with dry-land seed. All strains were from the same original source. In 1921 the several dry-land strains yielded at the rate of 198 bushels per acre. The strains irrigated one year yielded 94 per cent, those irrigated two years 40.4 per cent, and those irrigated three years 22.2 per cent as many bushels of potatoes as the dry-land strains. Other experiments conducted elsewhere yielded similar results. Evidently, potatoes of the Triumph variety irrigated more than one year are not very desirable for seed purposes.

Effect of varying amounts of irrigation on seed potatoes.—In 1920, 75 tubers of several varieties were split lengthwise into four pieces. One piece of each tuber was planted in each of four plats located in the same field, but separated by several other rows of potatoes. Each hill was marked with a wire stake and metal label. One plat was not irrigated, one was given light irrigation, one received a medium amount of irrigation water, and one was irrigated excessively. The potatoes from each hill were saved separately and were all planted in 1921 under irrigation. Table 15 shows the results obtained in 1921 from the potatoes that were grown under the various conditions the previous year.

TABLE 15.—*Yield of potatoes grown under uniform irrigation treatment from seed from lots treated differently the previous year, Scottsbluff Experiment Farm, 1921.*

Culture previous year.	Yield per acre (bushels).	
	U. S. grade No. 1.	Total yield.
Dry land	161.2	204.8
Light irrigation	139.2	196.7
Medium irrigation	107.6	157.0
Heavy irrigation	108.8	138.7

Evidently the amount of irrigation has some relation to the value of the potatoes for seed purposes. The relation of the amount of irrigation and method of irrigation is being further investigated.

Other phases of experimental work.—Other phases of experimental work with potatoes are in progress, but are not sufficiently advanced to warrant a report at this time.

A comprehensive experiment is being conducted to determine the cause of degeneracy and the rate of degeneracy under irrigated and dry-land conditions. This study involves four varieties. The relation of type to yield and number of tubers produced per plant is being investigated. It is hoped to isolate several high-yielding strains of potatoes and also to determine the most feasible method of seed selection.

Further experiments are being conducted to determine the effect upon seed potatoes of various degrees of culture on dry land and under irrigation.

The value of mature or immature potatoes for seed is being investigated by planting and harvesting potatoes at 20 different dates and then planting the product in comparison the following year.

All of these experiments, as well as strain and variety tests and distance of planting experiments, are being conducted both on dry land and under irrigation at the experiment farm.

EXPERIMENTS WITH CORN.

EFFECT OF ALFALFA ON YIELD.

Corn is the most neglected crop grown in the North Platte Valley. It is usually put on the poorest land on the farm and receives little or no care. Corn is more profitable than the small grains, especially if hogs do the harvesting. Corn yields well when following alfalfa. When it is grown on alfalfa land and given proper care it should yield between 50 and 70 bushels per acre. Yields as high as 82 bushels per acre have been produced from alfalfa land in the rotations on the experiment farm. The residual effect of alfalfa is very beneficial to corn, as will be seen from Table 16.

TABLE 16.—*Effect of alfalfa on yields of corn at the Scottsbluff Experiment Farm, 1921.*

Item.	Check plats.	Alfalfa plats.
Number of plats	4	2
Maximum yield ... bushels	41.5	74.0
Minimum yield ... do	31.3	68.0
Mean yield ... do	36.1	71.0
Yield in favor of alfalfa ... do		34.9

WHERE TO OBTAIN SEED CORN.

Although the North Platte Valley is 4,000 feet above sea level, corn in most years matures well. It is necessary, however, to plant early-maturing varieties. A safe practice is to procure seed from some farmer in the neighborhood who has grown corn successfully for years. There are a number of very good varieties grown by different farmers in the valley. Getting seed from a section with a longer growing season is a mistake too often made in trying to obtain a higher yielding variety. Such seed when brought into a district with a short growing season fails to mature. Tests at the experiment farm have shown that corn of the same variety when grown under different climatic conditions becomes gradually adapted to its environment, and in so doing acquires distinct characteristics. This was shown by a test made during the summers of 1917 and 1918, when Calico corn that had been grown for years in the eastern part of Nebraska was grown side by side with Calico corn that had been grown in the North Platte Valley for some 15 or 20 years. These two strains originally came from the same source. The eastern strain grew much taller and had larger ears than the local strain. However, the corn from the local-grown seed was well matured by the middle of September, while that from the eastern-grown seed was still green.

Even in 1918, when killing frost did not occur until October 26, the corn from the eastern-grown seed was but little past the dough stage when frost came. The average yields from these two strains of Calico corn during the years 1917 and 1918 were 67 bushels per acre of well-matured corn from the locally-grown seed and 48 bushels per acre of very soft corn from the eastern-grown seed. When it is desired to try a new variety from a section where the growing season is longer it should be tested on a small scale the first year or two.

DRY-LAND FARMING.[4]

Many farmers on the project have dry land in connection with their irrigated land. Most of this is used as pasture, and is usually so badly overgrazed that it produces but little feed. Much of the land is tillable, and could be made a source of greater income than it provides as native pasture.

To determine the agricultural possibilities of this land and the best method of crop rotation and cultivation to practice on it, the Office of Dry-Land Agriculture Investigations is conducting investigational work on the Scottsbluff Experiment Farm. About 30 acres of land that have never been irrigated are used for this work, which includes experiments with crop rotations and methods of tillage. The principal crops used are corn, winter wheat, spring wheat, oats, barley, and sorghum. The results obtained are not considered in detail in this report, but it may be of value to refer to some of the more important of them.

Table 17 gives the average yields of the several crops from all methods for each year of the 10-year period from 1912 to 1921, inclusive. The work was started in 1911, but the crops that year were all on virgin prairie sod, and the results will not be considered in this report.

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[4] This summary of results was prepared by Clarence Harris, of the Office of Dry-Land Agriculture Investigations.

The average yield of winter wheat for the 10 years is 10.6 bushels per acre, which is 1.2 bushels less than the average yield of spring wheat for the same period. This lower average of winter wheat is due either to complete winterkilling, as in 1918, or to partial winterkilling on some methods of preparation in other years. When the crop comes through the winter it generally yields more than spring wheat. When the winter wheat crop is credited with the spring wheat produced by reseeding winterkilled plats its yield is 13.1 bushels per acre, or 1.3 bushels higher than that of spring wheat. Of the 10 years, there has been 1 year of complete and 2 years of partial winterkilling.

The 10-year average yield of winter wheat on fallow was 13.8 bushels and on disked corn ground 9.6 bushels, while on land continuously cropped to wheat the yield was only 6.2 bushels on early fall plowing and 3.8 bushels on late fall plowing.

Spring wheat averaged 11.8 bushels per acre for the 10 years. Two of the 10 years were practically total failures. On summer tillage the 10-year average of three plats was 16 bushels per acre. Eleven plats on disked corn ground averaged 12.5 bushels. The yield on fall-plowed corn ground was 12.2 bushels and on spring-plowed corn ground 11.1 bushels. Other yields were 10.1 bushels on fall-plowed oat ground, 10.4 bushels on spring-plowed oat ground, and 9.8 bushels on spring-plowed sorghum ground. On land continuously cropped to wheat the average fell to 7 bushels on fall plowing and 6.3 bushels on spring plowing.

The 10-year average yield of oats was 24.1 bushels per acre. Four plats on summer tillage averaged 29.9 bushels, eight plats on disked corn ground averaged 25.9 bushels, two plats of spring-plowed corn ground 23.5 bushels, and two plats on spring-plowed wheat ground 23.4 bushels. Land cropped continuously to oats averaged 16.1 bushels on fall plowing and 17.4 bushels on spring plowing. The yields on one plat of spring-plowed sorghum ground averaged 26.3 bushels.

The 10-year average yield of barley was 15.2 bushels. The average yield on fallow was 26.9 bushels, on spring-plowed oat ground 17.3 bushels, on disked corn ground 15.1 bushels, and on land cropped continuously to barley 13.5 bushels on fall plowing and 16.2 bushels on spring plowing.

The 10-year average yield of corn was 20.7 bushels. One plat grown on fallow ground averaged 25.5 bushels. Outside of this plat the range in yield, due to differences in the preceding crop or the time of plowing, was so small as to be insignificant. The poor showing of corn after corn is doubtless due to the unfavorable location of the plats used in this method. In addition to the grain, the corn averaged 1,916 pounds of stover per acre.

Three plats of sorghum are grown in the rotations. The 10-year average yield of this crop was 5.454 pounds per acre. The heaviest yield was on spring-plowed corn ground manured; this for 10 years averaged 6,240 pounds.

Red clover failed consistently for eight years, and the past two years it has been replaced by sweet clover. No crop was secured the first year, but the second year a single plat yielded at the rate of 620 pounds per acre.

TABLE 17.—*Average yields of the several crops grown without irrigation on the Scottsbluff Experiment Farm for the 10-year period from 1912 to 1921, inclusive.*

Year.	Average yields per acre.					
	Winter wheat.	Spring wheat.	Oats.	Barley.	Corn.	Sorghum.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Pounds.*
1912	13.3	17.0	34.4	26.7	38.9	10,400
1913	10.0	11.6	25.0	.....	30.1	6,400
1914	21.9	10.7	17.3	7.7	10.1	250
1915	24.4	18.1	52.6	38.8	12.9	7,700
1916	51.7	8.2	10.4	8.4	29.1	8,800
1917	6.9	15.6	24.2	15.5	26.8	8,260
1918	.5	11.4	25.8	17.1	18.2	4,110
1919	4.5	2.3	2.8	4.7	5.6	2,487
1920	8.7	17.6	36.5	24.9	26.6	3,183
1921	10.3	5.8	12.5	8.5	8.2	3,950
Average	10.6	11.8	24.1	15.2	20.7	5,454

Brome-grass has not made a stand when seeded with a crop of grain. When seeded alone it has made a sod that in the second or third years yielded from 700 to 800 pounds per acre of hay. It possesses some possibilities for late or very early pasture. Alfalfa has been somewhat more productive than brome-grass, its average yield being about 1,200 pounds per acre. The beneficial residual effect of alfalfa shown under irrigation is not evidenced on dry land. Following alfalfa or brome-grass the soil is so dry that the yields are likely to be decreased rather than increased.

It appears from evidence obtained from the experiments without irrigation that small grains can be successfully grown on either fallow ground or following corn, but that their yields following small grain are too low to warrant their growth in such combinations unless at seeding time the soil is thoroughly wet to a depth of at least 3 feet. Fallow land should be seeded to winter wheat. Corn did not show sufficient increase to justify fallowing for that crop. Corn may be grown continuously on the same land if one so desires.

For forage alone sorghum is the most productive and the surest crop that has been grown. It should be expected to produce from 2.5 to 3 tons per acre. If corn is wanted for feed to use with alfalfa hay produced under irrigation, the dry land can be profitable utilized by cropping it continuously to corn. If a combination of feed and a cash crop is desired, the indicated rotation is a very simple one of corn on either spring or fall plowing and wheat on disked corn ground.

EXPERIMENTS IN CROP UTILIZATION.

ALFALFA PASTURE FOR HOGS.

Hogs harvest the third-year alfalfa plats in one of the series of irrigated rotations. The alfalfa in this rotation is seeded in oat stubble in the fall. During the past few years when grasshoppers were troublesome it was impossible to get a good stand from this method of seeding. The plat grazed during the summer of 1921 was of a rather poor stand and as a consequence would not carry the usual number of hogs. The returns from pasture in 1921 were the lowest of any season since the experiment began. Two lots of hogs were used. Fall-farrowed shotes are used in the first period and spring-farrowed pigs in the second period.

The plat covers a quarter acre and is divided into two parts, which are grazed alternately. The hogs are fed a 2 per cent ration of corn while on pasture. The results of 1921 compared with an 8-year average, all figured to the basis of 1 acre, are shown in Table 18.

TABLE 18.—*Results of pasturing alfalfa with hogs at the Scottsbluff Experiment Farm in 1921 compared with the average for the 8-year period from 1913 to 1920, inclusive.*

Items of comparison.	Season of 1921.			Eight-year average.
	Spring period.	Summer period.	Total.	
Number of hogs on pasture ..... per acre.	16	32	.....	.....
Total initial weight ..... pounds..	2,180	3,240	.....	.....
Total gains made ..... do....	1,000	1,476	2,476	3,025
Total corn fed ..... do....	3,048	3,752	6,800	7,686
Corn fed per pound of gain	3.05	2.54	2.75	2.54
Financial statement:				
Net return from pasture, per acre	$37.39	$63.17	$100.56	$129.65
Cost per hundredweight of gain, pasture at $15, corn at $1.07 per hundredweight	3.96	3.26	3.54	3.21

If the value of the gains made is figured at $7 per hundredweight and the corn fed at 60 cents per bushel, the net return per acre of alfalfa pasture is $37.39 for the first and $63.17 for the second period,

FIG. 4.—A general view of the feed lots used for lamb feeding on the Scottsbluff Experiment Farm in 1921.

making a total of $100.56 for the season. On the same basis, the average net returns for eight years is $129.65 per acre. The average yield of all the alfalfa plats in the rotations was 3.77 tons per acre. On the basis of this yield the hogs paid $26.67 per ton for the 1921 hay crop. The average yield for seven years of similar alfalfa plats was 5.01 tons per acre. At this rate the hogs returned annually a value of $25.88 per ton for the hay harvested in the field. The average pork produced per acre for the 8-year period was 3,025 pounds. It required 254 pounds of corn in addition to the alfalfa pasture to produce 100 pounds of pork.

LAMB-FEEDING EXPERIMENTS.[5]

The lamb-feeding tests that were conducted during the winter of 1919–20 were duplicated during the winter of 1920–21. (Table 19.) In this experiment there were 12 lots of 25 lambs, which were on feed 120 days. The lambs cost $11 per hundredweight at Denver. Allowing for freight and shrinkage the lambs cost $12 per hundredweight weighed into the feed lots. At the beginning of the experiment the lambs averaged 44 pounds each. The lambs in each lot were fed all the alfalfa hay they would eat. The lots getting beet tops were also fed all the tops they would clean up. Silage was fed at the rate of a little more than 2 pounds for each lamb daily. Corn and dried pulp

FIG. 5.—One of the pens of lambs at the close of the feeding period, Scottsbluff Experiment Farm.

were fed at the rate of 1 pound per lamb daily and cottonseed cake at the rate of one-third of a pound, except in the case of lot 7, where the lambs were fed cake at the rate of half a pound a day.

At the end of the experiment the lambs were appraised by an experienced sheepman from a commission company in Omaha. In figuring the total loss for each lamb a 6-pound shrinkage was allowed between the feed lot and market and also 65 cents to cover interest and shipping and commission charges.

The prices of feeds were as follows: Corn, $1.20 per 100 pounds; dried pulp, $35 per ton; cottonseed cake, $38 per ton; silage, $5 per ton; beet tops, 50 cents per ton yield of beets; alfalfa hay, $10 per ton. A general view of the lamb-feeding pens is shown in Figure 4; a closer view of one of the lots at the end of the feeding season is shown in Figure 5.

[5] The livestock tests reported on this and the following pages were conducted for and under the supervision of the Nebraska Agricultural Experiment Station.

TABLE 19.—*Summarized results of feeding 300 lambs in 12 lots with different rations for 120 days on the Scottsbluff Experiment Farm during the winter of 1920–21.*

Lot.	Feed consumed per 100 pounds of gain.						Gains per lamb.	Cost of feed per 100 pounds of gain.	Appraised value per hundredweight.	Total loss per lamb.
	Alfalfa.	Corn.	Cottonseed cake.	Dried pulp.	Beet tops (from tons of beets).	Silage.				
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*			
No. 1	703	341	.....	.....	.....	.....	30.1	$7.60	$9.70	$1.61
No. 2	440	262	93	.....	.....	.....	38.9	7.11	9.95	1.35
No. 3	635	[1] 165	.....	[2] 218	.....	.....	28.7	8.97	9.65	2.05
No. 4	525	[1] 136	104	[2] 180	.....	.....	36.2	9.38	9.85	2.02
No. 5	770	.....	.....	455	.....	.....	25.0	11.81	9.50	2.89
No. 6	514	.....	104	313	.....	.....	34.8	10.02	9.75	2.30
No. 7	436	.....	[3] 132	266	.....	.....	41.0	9.34	9.85	.96
No. 8	223	.....	91	275	.....	615	39.6	9.18	10.00	1.79
No. 9	472	.....	155	.....	.....	1,360	23.2	8.71	8.50	2.86
No. 10	394	284	.....	.....	1.57	.....	36.1	6.17	9.80	.93
No. 11	372	.....	86	262	1.32	.....	41.6	8.74	9.90	1.67
No. 12	617	.....	132	.....	2.27	.....	27.4	6.72	9.00	1.89

[1] Fed 40 days. [2] Fed 60 days. [3] At the rate of half a pound per lamb per day.

The results of this feeding test are grouped in Table 20 to show the comparative value of the different rations.

TABLE 20.—*Comparative results of using different rations in feeding 300 lambs in 12 lots on the Scottsbluff Experiment Farm during the winter of 1920–21.*

Feeds compared.	Apportionment of rations.	Gains per lamb (pounds).	Cost of feed per 100 pounds of gain.	Appraised value per hundredweight.	Total loss per lamb.
Corn and dried pulp (without cottonseed cake):					
Lot No. 1	Corn	30.1	$7.60	$9.70	$1.61
Lot No. 3	Dried pulp and corn	28.7	8.97	9.65	2.05
Lot No. 5	Dried pulp	25.0	11.81	9.50	2.89
Corn and dried pulp (with cottonseed cake):					
Lot No. 2	Corn and cottonseed cake	38.9	7.11	9.95	1.35
Lot No. 4	Dried pulp, corn and cottonseed cake.	36.2	9.38	9.85	2.02
Lot No. 6	Dried pulp and cottonseed cake.	34.8	10.02	9.75	2.30
Corn with and without beet tops:					
Lot No. 10	Corn and beet tops	36.1	6.17	9.80	.93
Lot No. 1	Corn	30.1	7.60	9.70	1.61
Other feeds with and without beet tops:					
Lot No. 11	Dried pulp, cottonseed cake, and beet tops.	41.6	8.74	9.90	1.67
Lot No. 6	Dried pulp and cottonseed cake.	34.8	10.02	9.75	2.30
Beet tops and silage (with other feeds):					
Lot No. 11	Dried pulp, cottonseed cake, and beet tops.	41.6	8.74	9.90	1.67
Lot No. 8	Dried pulp, cottonseed cake, and silage.	39.6	9.18	10.00	1.79
Beet tops and silage (with cottonseed cake):					
Lot No. 12	Cottonseed cake and beet tops.	27.4	6.72	9.00	1.89
Lot No. 9	Cottonseed cake and silage	23.2	8.71	8.50	2.86
Dried pulp, with heavy and with light feed of cottonseed cake:					
Lot No. 7	Dried pulp, with heavy feed of cottonseed cake.	41.0	9.34	9.85	1.96
Lot No. 6	Dried pulp, with light feed of cottonseed cake.	34.8	10.02	9.75	2.30

With the prices of feed that prevailed during this feeding test, the following conclusions can be drawn: (1) Corn in each case made more and cheaper gains than dried pulp, with a higher appraised value and a smaller loss per lamb; (2) cottonseed cake when fed with corn or dried pulp increased the gains made, lowered the cost per 100 pounds of gain, increased the appraised value, and decreased the loss per lamb; (3) beet tops proved a cheap feed when fed with either corn or dried pulp; (4) beet tops produced a little higher gain at a lower cost than corn silage; (5) a half-pound daily ration of cottonseed cake was more profitable than a ration of one-third pound.

Nine lots of the best lambs were sold on the Omaha market on March 28 at $9.75 per 100 pounds. In order to get data on the amount of shrinkage, dressing percentage, and quality of meat from the lambs fed different rations, seven lots were marked and weighed just before leaving the feed lots. Table 21 gives the ration fed, number of pounds shrinkage per lamb, and the dressing percentage for each lot, as furnished by Swift & Co., who bought the lambs.

TABLE 21—*Ration fed, number of pounds shrinkage per lamb between feed lot and market, and dressing percentage, for seven lots of lambs fed at the Scottsbluff Experiment Farm during the winter of 1920–21.*

Ration fed.	Shrinkage per lamb (pounds).	Dressing percentage.
Corn, hay	6.8	46.30
Corn, hay, cake	7.4	47.79
Pulp, hay, cake	7.6	47.35
Corn, hay, tops	9.2	48.56
Pulp, hay, tops, cake	9.6	47.91
Pulp, hay, corn	7.2	44.64
Pulp, hay, silage, cake	8.6	48.16

The packers classified the meat from each of these lots as being "good." In the past pulp-fed lambs have been discriminated against. It was claimed that the meat from pulp-fed lambs was of a poor quality. From data furnished by Swift & Co. on two different occasions it is evident that there is little difference in the quality of meat from corn-fed or pulp-fed lambs. The lambs having the highest finish sold for the most money in every case. Pulp-fed lambs sold as high as corn-fed lambs having the same finish.

DAIRY COWS.

The dairy herd during the summer of 1921 consisted of 13 cows, 1 bull, and some young stock (fig. 6). The bull and two cows are pure-bred Holsteins, while the others are grade Holsteins. The cows are fed alfalfa hay, silage, and beet tops during the winter and pastured during the summer. A small ration of grain is fed during the lactation period. No experiment, except in the way of pasturing tests and minor feeding tests, is being conducted. Records are kept of the milk and butter fat produced and of the feed consumed. Table 22 gives the amount of milk and butter fat produced in 1921 and the total amount produced on the station, with the yearly average.

TABLE 22.—*Milk and butter-fat production of the dairy herd at the Scottsbluff Experiment Farm, 1914 to 1921, inclusive.*

Cow.	Testing period.		Production in 1921.		Production to date.		Yearly averages.	
	Years.	Months.	Milk.	Butter fat.	Milk.	Butter fat.	Milk.	Butter fat.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Mabel	5	5	.....	.....	47,258	1,278.6	8,724	236
Bess	4	5	13,665	406.9	45,015	1,401.8	10,192	317
Marie	7	.....	7,053	219.2	54,868	1,587.3	7,838	227
Rose	3	6	.....	.....	19,789	766.1	5,654	219
Alice	1	4	.....	.....	6,049	210.1	4,537	157
Amy	1	4	.....	.....	6,285	197.0	4,714	148
Liza	1	7	.....	.....	8,020	274.0	5,065	176
Frances	0	10	.....	.....	4,002	148.4	4,802	178
Hulda	2	4	.....	.....	11,174	365.3	4,780	156
Stella	1	0	.....	.....	3,578	151.8	3,578	152
Wonder	1	3	.....	.....	6,114	256.0	4,890	205
Beauty	6	.....	8,425	279.8	41,496	1,447.1	6,916	241
Sarah	1	8	8,007	259.8	14,513	467.7	8,708	280
Anna	1	9	.....	.....	7,661	198.8	4,378	114
Maud	6	9	5,392	193.9	44,635	1,493.9	6,612	221
Colantha	2	2	10,110	349.8	19,832	679.2	9,153	313
Eva	4	5	4,472	117.2	23,749	692.9	5,370	157
Goldie	2	.....	7,682	251.3	14,682	462.7	7,341	231
Colantha S	2	6	8,852	297.7	20,255	669.7	8,102	268
Ellen	1	0	5,936	199.4	5,936	199.4	5,936.1	199
Quality	1	0	7,967	250.0	7,967	250.0	7,967	250
Stinnie	1	0	6,530	203.8	6,530	203.8	6,530	204
Queen [a]	0	6	4,683	174.0	4,683	174.0	4,683	174

[a] The figures under a yearly average are for a 6-month period only.

FIG. 6.—The dairy herd and barn on the Scottsbluff Experiment Farm in 1921.

The time used in this table is the calendar year. Bess is the highest producing cow in the herd, with a yearly average of 317 pounds of butter fat for four years and five months. In 1921 she produced 13,665 pounds of milk and 406.9 pounds of butter fat. In all, the table gives the record of 60.75 cow-years with an average production of 223.4 pounds of butter fat per cow per year. The average amount of butter fat produced by the 13 cows in 1921 was 246.3 pounds.

Corn silage compared with beet tops.—A short feeding test, comparing corn silage with beet tops for dairy cows, was conducted during the fall of 1921. Five cows were used in this test, covering a period of

eight weeks. The cows were changed from one feed to the other every two weeks. The same amount of grain was fed in both cases, and the cows had access to alfalfa hay at all times. The results from this test are given in Table 23.

TABLE 23.—*Milk production from five cows when alternated from corn silage to beet tops at intervals of two weeks at the Scottsbluff Experiment Farm, 1921.*

Each feed—	Maude.		Beauty.		Bess.		Colantha.		Marie.		Total.	
	Silage.	Beet tops.	Silage.	Beet tops.	Silage.	Beet tops.	Silage.	Beet tops.	Silage.	Beet tops.	Silage.	Beet tops.
Time.....days..	28	28	28	28	28	28	28	28	28	28	140	140
Milk produced:												
Total.....pounds..	1,452	1,512	1,057	1,091	914	912	1,388	1,359	768	718	5,579	5,592
Daily.....do....	51.8	53.9	37.7	38.9	32.6	32.6	49.5	48.4	27.4	25.6	39.9	39.9

The production from two cows was higher when fed beet tops, two were higher when fed silage, and one produced equal amounts from each. The average of the five was the same for both beet tops and silage. It is believed by some that beet tops "dry cows up." This is true only when the cows eat too many tops and not enough other feeds. Cows are very fond of beet tops and when given an unlimited amount will not eat enough proteid feeds to balance the ration for a large milk flow, and as a consequence, they dry up.

Sweet-clover pasture compared with grass pasture.—Seven cows that gave milk during the entire pasturing season were used in this test. The cows were alternated from one pasture to the other at intervals of about two weeks. Four cows were on sweet clover a total of 65 days and on grass a total of 67 days, while the other three were on sweet clover 67 days and on grass 65 days. A record of the milk produced shows that the daily average of four cows was in favor of sweet clover and the daily average of three cows was in favor of grass. The average for the seven cows was exactly the same for both pastures. A summary of the results is given in Table 24.

TABLE 24.—*Milk production from seven cows which were alternated from sweet-clover pasture to grass pasture at intervals of about two weeks at the Scottsbluff Experiment Farm during the summer of 1921.*

Each pasture—	Bess.		Marie.		Sarah.		Goldie.		Quality.		Ellen.		Stinnie.		Total.	
	Clover.	Grass.	Clover.	Grass.	Clover.	Grass.	Clover.	Grass.	Clover.	Grass.	Clover.	Grass.	Clover.	Grass.	Clover.	Grass.
Time....days..	65	67	65	67	65	67	65	67	67	65	67	65	67	65	461	463
Milk produced:																
Total, pounds..	2,758	2,689	2,078	2,016	1,739	1,684	1,704	1,592	1,635	1,703	1,228	1,350	1,164	1,341	12,306	12,376
Daily.....do...	42.4	40.1	32.0	30.1	26.8	25.1	26.2	23.8	24.4	26.2	18.3	20.8	17.4	20.6	26.7	26.7

STEER FEEDING EXPERIMENT.

During the winter of 1919–20 three lots of steers were used in a feeding test. There were 10 steers in each lot. They were of Shorthorn and Hereford breeding. The steers cost $11 per hundredweight at Denver, freight paid. With the shrink and other items of expense they cost $11.85 per 100 pounds, weighed into the experi-

ment. The experiment began on December 1, 1919 and closed on May 7, 1920, a period of 160 days. At the close of the experiment the steers were shipped to the Omaha market. The individuals in each lot were marked and were weighed separately at Omaha. A tabulated statement of the results is given in Table 25.

TABLE 25.—*Results from the steer-feeding experiment at the Scottsbluff Experiment Farm, 1919–20.*

Item.	Rations fed.		
	Alfalfa hay, dry pulp, cottonseed cake.	Alfalfa hay, dry pulp, cottonseed cake, beet tops.	Alfalfa hay, dry pulp, cottonseed cake, corn silage.
Initial weight per steer, feed lot ..... pounds..	802	800	802
Final weight per steer at Omaha ..... do....	1,081	1,097	1,132
Gains made per steer ..... do....	279	297	330
Feed required per 100 pounds gain:			
Alfalfa hay ..... do....	650	281	131
Dry pulp ..... do....	738	699	627
Cottonseed cake ..... do....	107	97	81
Tops from beets ..... tons..	.....	2.89	.....
Corn silage ..... pounds..	.....	.....	1,090
Cost of feed per cwt. of gain	$22.67	$21.41	$19.82
Selling price per cwt. of steers	12.75	12.75	13.00
Total cost per steer	158.12	158.71	160.35
Return per steer (net)	134.17	136.18	143.39
Loss per steer	23.95	22.53	16.96

As will be seen from the table, the gains made cost more than the market value. The lot getting alfalfa hay, dry pulp, and cottonseed cake lost a total of $23.95 per steer over and above the cost of labor and the interest on the investment. When beet tops were added to the ration the loss was $22.53 per steer, and when corn silage was added to the ration the loss was only $16.96 per steer. Corn silage at $8 per ton proved a cheaper feed than beet tops at $1 per ton yield of beets.

RANGE PASTURE.

During the summer of 1920, 82 head of cattle, yearlings, and 2-year-old steers were grazed on the 800-acre native pasture. These steers were turned into the pasture the middle of April but were fed cottonseed cake daily until the fore part of May. On June 3 they were taken from the pasture and weighed and after being dehorned were returned to pasture. They were removed from the pasture and weighed on October 23. The gains made by the steers from June 3 until October 23 are given in Table 26.

TABLE 26.—*Gains made by steers on native pasture from June 3 to October 23 (142 days) on the Scottsbluff Experiment Farm, 1920.*

Item.	Kind and number of steers.		
	35 2-year-olds.	15 yearlings.	32 yearlings.
Average initial weight ..... pounds..	708	498	462
Average final weight ..... do....	931	696	666
Average gain per steer ..... do....	223	198	204
Daily gain per steer ..... do....	1.57	1.40	1.44

There were 142 days between the weighings. During this time the 2-year-olds each made an average total gain of 223 pounds, or an average daily gain of 1.57 pounds.

One lot of yearlings made an average total gain of 198 pounds, and the other lot of yearlings made 204 pounds. The average daily gain for the yearlings was 1.4 pounds for one lot and 1.44 pounds for the other lot.

IRRIGATED PASTURES.

As pasture is very essential to successful dairying, work has been conducted during the past years for the purpose of getting information on the value of different pasture crops and the method of handling such crops for the best results. The two most promising pasture crops seem to be sweet clover and a grass mixture. The value of manure on grass pasture is also being worked out.

Grass pasture.—During the summer of 1921 the results obtained from the pasturing tests were not entirely satisfactory, due to a shortage of water, caused by a break in the canal. Grass pasture requires frequent irrigation for the best results. For maximum yield on the light soils on the North Platte project it also requires applications of manure. During the past four years a small grass pasture of 1.6 acres has received each winter an application of between 12 and 15 tons of manure per acre. By applying this manure, the carrying capacity of the pasture has been increased about three times. During the summer of 1920 this pasture carried four large Holstein cows continuously. Due to lack of water, it did not carry so many during the summer of 1921.

In a manuring test, which was begun in the spring of 1920, the results showed that the carrying capacity of grass pasture was at least doubled by two-years' application of manure. Three lots of sheep were used in this test. The three pastures were divided into three parts and the sheep were changed from one to the other as the pasture required. One pasture received no manure, one received manure at the rate of 10 tons per acre, and the other received manure at the rate of 20 tons per acre. There is five-eighths of an acre in each pasture. The pasture that did not receive manure carried two ewes and three lambs, and each of the manured pastures carried four ewes and six lambs. The sheep were on pasture 102 days. The 10 sheep on each of the manured pastures did equally as well as the 5 on the pasture not getting manure. This, figured to an acre basis, would be equal to 16 sheep for the manured pastures and 8 for the nonmanured pasture. Had the pastures received sufficient water, this number of sheep would not have been able to keep the pasture grazed down.

Sweet-clover pasture.—Sweet clover is proving a very satisfactory pasture crop on the North Platte project. While there are cases of cattle bloating from eating sweet clover, it is not nearly so dangerous as alfalfa. There has never been a case of bloat from eating sweet clover at this station. During the summer of 1921, 3 acres of sweet clover that had been seeded with wheat in the spring of 1920 was pastured by dairy cows. Twelve cows were turned into the 3-acre pasture in the spring, and had it not been necessary to remove them for about two weeks because the pasture stopped growing on account of a lack of irrigation water, it would have carried 12 cows during

the entire summer. This is the equivalent of four cows per acre. Dairy cows do well on sweet-clover pasture. With a good stand and when given proper care sweet-clover pasture should easily carry three cows per acre with no additional feed. The advantages of sweet clover over grass as a pasture crop are that sweet clover requires less water, is established quicker, and is a soil builder rather than requiring manure. The disadvantage is that a new field must be seeded each year for pasture the following summer, and should there be a failure in getting a stand the farm would be without pasture the following year.

Perhaps the best time and method of seeding sweet clover is early in the spring with barley as a nurse crop. The following four-year rotation is suggested for those who wish to grow sweet clover for pasture: (1) Barley and sweet clover, (2) sweet-clover pasture, (3) potatoes, corn, or beets, and (4) corn or beets. As grasshoppers do not damage sweet clover seriously, a stand of it is not so difficult to get as of alfalfa. It is evident that sweet clover has a beneficial effect on succeeding crops, just as is the case with alfalfa.

In a four-year rotation that was begun in the spring of 1920 a sweet-clover plat is pastured by sheep. The quarter-acre plat is divided and the sheep alternated as the pasture requires it. Six ewes and six lambs were used to graze the plat during the summer of 1921. This number proved to be too many for the quarter-acre pasture and it was necessary to remove the sheep to other pasture at two different times during the summer. The sheep were on this pasture 70 days, or a total of 840 sheep-days. On an acre basis this would be 3,360 sheep-days, or the equivalent of 28 sheep for four months.

THE SCOTTSBLUFF EXPERIMENT FARM is located on the North Platte Reclamation Project, 6 miles east of Mitchell and about 8 miles northwest of Scottsbluff, Nebr. The farm includes 160 acres of land, and the work is supported cooperatively by the United States Department of Agriculture and the Nebraska Agricultural Experiment Station. Operations on this farm were begun in 1909.

In 1917 the Federal Government deeded to the University of Nebraska 800 acres of land located 5 miles north of the experiment farm, to be made a part of it, for the purpose of conducting grazing experiments.